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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Telephone: Central 1868. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 392*).

Forthcoming Events.

MAY 5-6.

Iron and Steel Institute:—Annual meeting and dinner in London.

Institute of British Foundrymen.

APRIL 23.

Newcastle-upon-Tyne and District Branch:—Annual general meeting, and general discussion on Foundry Problems.

APRIL 29.

London Branch (Junior Section):—Annual general meeting in London.

APRIL 30.

Newcastle-upon-Tyne and District Branch (Junior Section):—Annual general meeting, and general discussion.

West Riding of Yorkshire Branch:—Annual general meeting at Bradford.

MAY 7.

Lancashire Branch:—Ordinary meeting at Manchester. "Silicon as an Alloying Element," Paper by J. Arnott, A.I.C.

MAY 12.

London Branch:—Annual general meeting. "Crucible Melting Furnaces," Paper by G. L. Cassidy.

Sales Propaganda.

We have examined from time to time during the past few months a certain amount of literature of American origin, issued in connection with the welding industry, and the method of approach in sales propaganda adopted in that country offers interesting comparisons with that which is, or which would be, adopted in this country. We refer principally, of course, to the attempt to capture for the welding industry business which has hitherto gone either to the ironfounders or the steelfounders. We have also examined some of the counterblast put up by the ironfounders in the States. The most significant feature of this is the fact that an organised attempt is being made to meet the welding competition. In this country the situation is such that the industry has no organised channel through which such an effort may be made. The manufacturers' organisations are not as fully representative or as fully supported as they should be, and only certain sections of the industry are, as yet, feeling the competition. There is also the fact that firms adopting welded structures have in many cases their own foundries and welding shops, and are able to adopt either construction according to their own convenience. The latter fact is really one of the bright spots in the situation, although at first sight it might appear damaging to the foundry industry. Such firms can be trusted to be impartial between the two methods and ultimately to follow that practice which is most justified from the technical and commercial points of view. Furthermore, it is notoriously difficult to put over in this country sales propaganda which cannot be justified up to the hilt by results. We are slow to move, but the movement is generally in the right direction. Sales propaganda, therefore, which is based on excessive claims and too optimistic forecasts soon defeats itself, and, indeed, goes further, for once users in this country have been "bitten" as a result of over-claiming, their minds are closed to what may be real possibilities in new proposals made, after the optimism has been discounted. America presents rather a different situation. It is probably true to say that over-claiming is so general in American sales propaganda that the average American user will discount it liberally in advance, and so the more temperate presentation to which we are accustomed does not raise any enthusiasm among them. These facts have to be borne in mind in reading welding propaganda which comes from American sources. While sometimes difficult in itself to refute, it mainly displays a rosy optimism on behalf of welding together with a convenient unwillingness to discuss certain awkward points. It also definitely makes, on occasion, damaging statements about the use of castings themselves, which have been responsible in part for the creation of a new organisation for the purpose of standing up for the casting and ensuring fair treatment. The case is thus not allowed to go by default.

We find in the two methods of approach one reason for the much greater oscillations in business between boom and depression in America as compared with this country. In any given industry persistent over-claiming or over-selling creates at one point an artificial peak and a little later an equally artificial depression, arising from the buyer "holding off" as a consequence of his disappointment.

Do Volatiles Vitiate?

It is very desirable that a phase in furnace reactions should receive the attention of every trained metallurgical mind, as at the moment gossip germane to it is creating a dangerous position by broadcasting unproved generalities. We refer to the various statements condemning fuels possessing a high volatile content by postulating that as their products of combustion contain water vapour, this, at high temperatures, reacts with molten metals giving deleterious results. It may be due to the researches of Hansen on pinholing in aluminium-alloy castings, from which he has expressed a preference for coke firing, as this fuel, being virtually free from serious volatile-gas content, is incapable of producing water vapour. Some metallurgists have mentally exterpolated this particular function to include ferrous and heavy non-ferrous alloys generally. Primarily, we would point out that the standard method for the large-scale melting of steel is by producer-gas fired furnaces, and no ill-effects have been so far ascribed to this. Oil is currently used for melting bronzes and brasses, and again is deemed to be a thoroughly reliable medium. Moreover, even for light alloys, we could marshal incontrovertible evidence that some foundries are melting with oil and are not troubled with pinholes or other defects in any way ascribable to the fuel used.

We have even heard of a critical temperature, above which high-volatile fuels are said to act adversely on liquid iron and steel. This deleterious action is supposed to be related to the existence of a breaking-down temperature of

steam into hydrogen and oxygen, and the latter in its nascent stage is supposed to be extremely active in its attack on metals. We can see no safe foundation for such fantastic assumptions, and, moreover, we feel reasonably assured that research workers would not appreciate such wholesale generalisations from results which were meant to be applied within a restricted field. They would be the last to postulate that high-volatile fuels can be represented as a mathematical constant. They realise that by varying pressures, volumes, quantity and temperature of air for combustion, the type of burner used and the flue arrangements, a wide range of conditions can be instituted with entirely different results on the metal being melted. This final statement is abundantly proved in numerous manufacturing concerns in Great Britain.

Institute Elects New Members.

At a meeting of the General Council of the Institute of British Foundrymen, held at the Hotel Metropole, Blackpool, last Saturday, the following were elected to the various grades of membership.

As Subscribing Firm.

George Garner & Sons, Limited, Canal Foundry, Victoria Street, Openshaw.

As Members.

G. H. Drummond, foundry manager, Saracen Foundry; A. J. Hinton, B.Sc. (Tech.), foundry manager, Platt Bros., Oldham; J. Paterson, foundry manager, Platt Bros., Oldham; F. L. Patterson, director, Cromil & Piercy, Limited, Newcastle; G. L. Robson, iron and steel merchant, Sunderland; D. R. Kinnell, ironfounder, C. P. Kinnell & Company, Thornaby-on-Tees; H. F. Poole, metallurgist and general manager, Keighley Laboratories; J. Sherwood, foundry manager, Wm. Marshalls & Sons, Gainsborough; H. W. Swift, M.A., D.Sc., head of Department of Mechanical Engineering, Bradford Technical College; J. H. Wright, foreman moulder, J. Henry, Limited, Leeds; Robt. Hay, Ph.D., Prof. of Metallurgy, Royal Technical College, Glasgow; A. A. B. Menzies, foundry foreman, United Engineers, Limited, Singapore; D. MacLean, representative, Sternol, Limited, Glasgow; H. W. Wright, ironfounder, Westcliff-on-Sea.

As Associate Members.

A. Anderson, patternmaker, Mackenzie & Moncur, Limited; W. R. Cooper, steel founder, F. H. Lloyd & Company, Wednesbury; F. Cuerden, iron moulder, Leyland Motors, Limited; T. Davis, iron moulder, Mechans, Scotstoun; H. E. Cavill, foundry foreman, Penney & Porter, Lincoln; A. L. Hewer, metallurgist, S. Fox & Company, Limited, Stocksbridge; V. W. Davidson, B.Met. (Sheffield), metallurgist, British & Dominions Feralloy, Limited; J. Dobson, steel moulder, Farington Steel Foundry of Leyland; G. Eccles, moulder, J. Stubbs, Limited; R. Robinson, moulder, T. Ashworth & Company, Limited; Wm. Rostron, foreman moulder, Hacking & Company; N. Scott, foundry representative, Farington Steel Foundry of Leyland; B. Swain, pupil engineer, G. Fletcher & Company, Derby; R. S. Hind, department superintendent, Ruston & Hornsby, Lincoln; W. H. Nicholds, foundry manager, Brown Bayley's Steel Works, Limited; G. C. Wilson, patternmaker, Carmuirs Iron Company, Falkirk.

As Associate.

R. F. Hudson, laboratory assistant, Glenfield & Kennedy, Limited, Kilmarnock.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Tank Plates.

To the Editor of The Foundry Trade Journal.

Sir,—We have recently been making tank plates, and one particular plate has invariably come out twisted. I should be glad if you, or any of your readers, could inform me as to the way to get a true plate every time.

The plate in question is 4 ft. 8 in. by 4 ft. 2 in. by ½ in. There is a flange 2 in. deep, without holes, on one of the shorter sides only. Bow-shaped strengthening ribs, 2 in. at deepest point, run diagonally across the plate on the same face as the flange. The plate is gated on the joint, at the end where the flange is. I should be particularly glad if anyone who has had this particular kind of plate will tell me how he kept it straight.—Yours, etc.,

"Jobbing Moulder."

Centrifugally-Cast Piston Rings.

To the Editor of The Foundry Trade Journal.

Sir,—In reference to the remarks of Mr. F. Hudson in his discussion on Dr. Everest's Paper which appeared on page 235 of your issue dated April 14, 1932, it may be of interest to Mr. Hudson to know that centrifugally cast-iron piston rings in the hardened and tempered condition are manufactured and can be obtained from the leading piston-ring manufacturers. Perhaps such rings might be of assistance in dealing with the difficulties which he recounts.—Yours, etc.,

J. E. Hurst.

The Beeches,
Green Lane, Dronfield.
April 19, 1932.

Moulding Hydraulic Cylinders.

To the Editor of The Foundry Trade Journal.

Sir,—I was greatly interested in Mr. McClelland's article on "Moulding a High-Duty Hydraulic Cylinder in Loam," which appeared on pages 231 *et seq.* in your issue of April 14. This was really good, but it must be some years since he saw one moulded in the way he described. I should like to suggest that it is cheaper to make the core reverse way to the cope, to turn it over and to lower into the mould. It would be better to run it from the top through the thickness and the cope would remain good for many castings in the same brickwork. I was also surprised with the questions he was asked, for it was quite evident that the methods were new to them.—Yours, etc.,

F. Wiles.

57, Nuttall Street,
Bolton.
April 18, 1932.

Art in Publicity.

At Blackpool, last week-end, Mr. Jas. M. Primrose handed to us an etching measuring 10 in. by 8 in. which illustrates the cupola plant installed at the works of the Grangemouth Iron Company, of Falkirk. The picture has been drawn by Mr. J. W. Davie, the headmaster of the local school of art. The plant illustrated is a pair of balanced blast cupolas having a melting capacity of 14 to 16 tons per sq. in. Our opinion on the artistic merit of the picture may be called into question, as we possess no qualifications coming within the term "art critic." However, we think the artist has made an excellent picture from poor material (from the artistic point of view), and the only fault we can find is a little too much heaviness in the outlining of the ladles in the foreground. Finally, we would congratulate all concerned on the production of a brilliant piece of foundry publicity.

Random Shots.

Sir Harold Bowden's suggestion of a Ministry of Leisure has been described as happy, but before "Marksman" subscribes to that opinion he would like to have a clearer idea of what is intended. In the first place, what is leisure? Does it include all that part of the day during which one is not breadwinning? Or does one have to subtract the time spent in sleep, over meals, in mowing the lawn and so on? "Marksman" seems to recollect the figure of 15 per cent. being given as the percentage of a lifetime during which one is at work—earning, that is. The figure seems to be very low; much lower, probably, than it really should be. But if our leisure hours were calculated out on the same basis they might easily amount to no more than about 10 per cent. You can correct "Marksman" if you care, because he feels that the percentage is too small for him to reduce it by working out a silly calculation such as this.

* * *

It is probably the arduousness of doing nothing that has led to the pursuit of hobbies. And hobbies are a curious index of a man's tastes and inclinations. The Editor, I remember, once reproduced a lot of designs of manhole covers, the collection of which must be quite a fascinating hobby—much more exciting than, say, making fretwood pipe racks. "Marksman" has several ideas for quaint hobbies which he intends to take up one day, providing his insurance company allows it. He has in mind the collection of "freak" waster castings. If any of his readers happen to have specimens of these perhaps they might be good enough to put them aside until such time as "Marksman" can come and collect them.

Marksman.

Notes from I.B.F. Branches.

Lincolnshire.—The annual meeting of the Lincolnshire Section was held at Lincoln Technical College on April 9. The election of officers for next session was as follows:—*President*, Mr. J. J. Feasey (re-elected); *Vice-Presidents*, Mr. J. Stone and Mr. T. Mather; *hon. secretary*, Mr. E. R. Walter (re-elected). The existing council was re-elected *en bloc*, and the following new members elected:—Mr. R. Atchison (Newark), Mr. T. Bryan (Lincoln) and Mr. E. Beck (Grantham). The hon. secretary, Mr. E. R. Walter, gave a review of the past year's work. The Section had progressed favourably. During the year there had been a works visit to Messrs. Ruston-Bucyrus, as a joint meeting with the East Midlands Branch, and they also attended the East Midlands Branch dinner at Nottingham. It was thought that they had undertaken good propaganda work during the year, and they looked forward to an increasing membership for the next session. It was regretted that their Vice-President, Mr. J. I. Coleman, had resigned his membership with the Section, owing to leaving the district.

Coke Research.—The Northern Coke Research Committee Annual Report for 1931. Published from Armstrong College, Newcastle-upon-Tyne.—Like most other bodies dependent on Governmental financial assistance, the Northern Coke Research Committee is fighting for its very existence. We are not particularly interested in results achieved by its sister organisations, but, in common justice, it must be acknowledged that the Northern Coke Research staff has done more for the foundry industry than all the others put together. We thus commend our readers, who are vitally interested in coke as a basic raw material, to procure this book, and to do their best to ensure that the work so ably initiated by Dr. H. V. A. Briscoe shall be continued.

The Enamelling of Cast Iron.*

By Bernard B. Kent.

Although it is only in recent years that porcelain enamel has become practically a universal finish for such everyday articles as refrigerators, stoves, washing machines and building materials, it must not be assumed that porcelain enamelling is a new art or scientific discovery. This finish was used for both ornamental and practical purposes over 2,000 years ago—jewels and objects of art being first produced by the Chinese and others of the Orient, many specimens of which can be seen to-day on exhibition in museums and art galleries.

Admittedly the composition of the enamel has changed considerably, while the process has been improved to such an extent as to make the production of porcelain enamel-ware a commercial proposition. Again, the recent discoveries obviating the presence of arsenic and lead in the enamel have made enamelling a safer job for the worker and produced a harmless finish for domestic use. Porcelain enamelling, or, to give it its full name, vitreous porcelain enamelling, is the process of coating metal, usually cast iron or steel, with a thin film of a kind of opaque glass. This process may be divided into four operations, namely: the manufacture of the enamel, or, as it is known to enamellers, "frit"; the preparation of the castings; spraying the enamel; and lastly, drying and fusing or burning the article. It might be mentioned at this stage that spotless cleanliness and absolute accuracy are essential for successful enamelling; "slipshod" methods and guesswork calculation are disastrous. At every stage, dust and dirt must be kept out of the enamelling shop, and such articles as mills, spray guns, sieves and storage tanks and bins must be kept scrupulously clean.

Production of Frit.

The modern frit is a composition of quartz, felspar, soda, saltpetre, borax, etc., fused together at a high temperature and rapidly cooled by pouring into tanks of cold water, thus producing a granulated material ready for the final mixing and grinding before being sprayed on the article. To-day, the production of this frit is a highly scientifically controlled process and is being manufactured by specialised firms in this country, America and Germany. Few porcelain enamellers make their own frit, but buy it in the granulated form ready for preparation to meet their own special requirements. In this form it keeps indefinitely and does not deteriorate in stock. For most enamellers, therefore, the first step is to grind down this material into a smooth fluid by the addition of water, vallendar clay and opacifier such as tin oxide and a colouring matter, generally a metallic oxide. Antimony oxide or cadmium sulphide produce yellow colours. Iron and gold produce red, and copper and cobalt produce greens and violets, while mixtures of these can produce a great variety of colours. A typical mixture consists of:—300 lbs. clear frit, 90 lbs. water, 12 lbs. clay, 12 ozs. oxide and 9 ozs. tin oxide. This mixture is put into a porcelain-lined cast-iron drum containing round flint pebbles and revolved for about 10 hrs., depending upon the fineness of the enamel and the speed and size of the drum. An average drum will hold about 400 lbs. of material and revolves at a speed of about 20 r.p.m.

The degree of fineness is measured in units. Coarsely-ground enamel is stated to be milled to, say, 6 units, while finely-ground enamel is milled to 1 or 2 units. In producing a "mottled" finish, the ground coat is usually milled to 6 units, while the white mottled effect is produced with an enamel milled to 1 unit. This test is made in the following manner: A measured quantity is taken from the mill, say 500 c.c., and poured through a sieve of standard fineness, about 150 mesh. The sieve is washed under a stream of running water until every possible particle has been washed through the sieve, the residue is then carefully dried and emptied into a graduated test-tube, the quantity of which remains measures the units of fineness. Obviously, if a fairly large quantity remains, the enamel is in a coarse state, while if practically all was washed through the sieve, little will remain to be put in the graduated tube, showing that the enamel was very finely milled and would probably be in the region of 1 unit fineness. This test is extremely important, and must be made two or three times during the grinding of each batch.

When the required fineness is reached, the mill is stopped, the lid removed and a pouring tap affixed. The enamel is then run into a storage bin to "age" prior to being used. If the operation of emptying is to be speeded up, a pressure of about 5 lbs. per sq. in. may be applied to the drum by connecting a tube to the air-cock, but it is not advisable to exceed this pressure owing to the risk of damaging the porcelain lining or the causing of unnecessary friction with the pebbles. The exact reason for the ageing of enamel is not definitely known, but it is generally accepted that the action of milling causes friction between the finely-divided particles and slightly heats up the mixture. It is found, therefore, that best results are obtained if the prepared enamel is allowed to stand for about 48 hrs. after milling. The mills need not be washed out after each batch of enamel if the same colour is to be ground, but should any other frit be introduced the mill must be thoroughly flushed with running water, and, if necessary, allowed to revolve for a short time with washed sand. The mill must never be allowed to run with pebbles only or the lining will become chipped or cracked.

Type of Casting Used.

It is not any kind of casting that can be successfully and easily enamelled. The composition, for instance, of the iron is important and should have an analysis approximately as follows:—T.C. 3.30, Gr 2.40, C.C. 0.90, Si 2.10 to 2.50, Mn 0.50 to 0.70, S 0.06 to 0.09 and P 0.30 to 0.60 per cent.

Moreover, the casting, which must be free from blow-holes and spongy places, must also be of uniform thickness and free from sharp corners or edges.

The enamel tends to flow away from a sharp edge leaving an unsightly black line, especially if the enamel is of a light colour, while it is difficult to heat a casting with a thick section in one place to an even temperature, and results in the enamel being either under-fired at this place or burnt in the thin sections. Further, the skin of the casting must be free from burnt-in sand, as this cannot be removed by sand-blasting, and would only cause blistering and black spots in the enamel. Fresh castings can often be successfully enamelled without first annealing, but castings that have been in stock must first be heated to drive off moisture that will have been absorbed by the pores of the iron.

Sand-blasting.

Assuming that a suitable casting had been produced, it must now be sand-blasted to remove all scale, rust and dirt, and, at the same time, the surface must be roughened so as to produce a surface on which the enamel can adhere or "key." This blasting must be done at a pressure of not less than 60 lbs. per sq. in., and the abrasive can be either silica-flint, angular steel grit or a mixture of both. It is generally stated that flint gives the best results, whilst most enamellers maintain that at least a proportion of flint must be present in the mixture, but the writer has obtained perfectly successful results using angular steel grit. The advantages of this over flint are many. It is quicker in its cleaning action, produces much less dust and is safer and healthier for the operator. When flint is used, special precaution must be taken as the men are liable to be attacked with silicosis, a disease which attacks the lungs. For most factories, this means a higher insurance premium must be paid for the workers.

When steel grit is used, it is advisable to remove the very fine particles; it has been found advantageous to sieve the abrasive through a 30-mesh sieve after every 200 hrs. working. The smaller shot need not be wasted and can be used in blasting the castings at low pressure before fettling. This sand-blasting operation is expensive, but, up to the present, no other practical method has been evolved. With a $\frac{5}{16}$-in. dia. nozzle and a working pressure of about 50 lbs. per sq. in., about 60 h.p. is required to drive the compressor, and, naturally, as the pressure is increased the h.p. required increases. American practice is to use $\frac{1}{2}$-in. nozzles at 90-100 lbs. pressure, but in this country a slightly smaller nozzle and lower pressure are favoured, although the cleaning action is slightly slower. The various methods of sand-blasting do not come within the scope of this Paper, but it can be said that either rotary tables, cabinets or barrels can be used. Unlike sand-blasting, to clean castings prior to fettling, individual attention must be given to each casting since the enamel will not adhere to any surface not thoroughly cleaned and roughened.

Assuming there are now available a perfectly-blasted casting and some correctly-milled enamel, the next operation is the spraying. This is accomplished in a spray booth fitted with a turn-table and exhausting fans to keep the sprayer free from the enamel vapours. For general coloured work, one coat of enamel and one firing suffice, but with plain or delicate colours a ground coat and one or two subsequent sprayings and firings are necessary. In producing a mottled surface, the base colour is first sprayed at a pressure of about 60 lbs. per sq. in., and the mottled effect is produced by spraying the white enamel at a low pressure of about 3-5 lbs. per sq. in. This low pressure causes the gun to "splash" the white over the base coat. It is especially important that as little enamel as possible be allowed to settle in the spray booth. Owing to the cost of the material it cannot be thrown away if the article is to be produced at a competitive price and must be salvaged and used again. Provided that the booth is kept clean, these scrapings can be collected daily, remilled and mixed with the fresh enamel. It will be found that to use all the scrapings the proportion of new to old enamel will have to be in the neighbourhood of 45 to 55 per cent., and within these limits good results can be obtained. Above this percentage, curling or uneven fusing of the articles will occur.

Great care must be taken in handling the sprayed articles, especially if the work is to be treated on both sides. Special supports must be prepared having points to support the casting, as each place of contact will produce a mark on the enamelled surface. Touching the castings with the naked hands must be avoided, as the grease from the skin will often prevent the enamel from adhering or cause it to blister or "curl."

Drying.

The sprayed castings are now placed in the drying house to drive off all moisture. This will take about 10 to 20 min., according to the

* Paper prepared for presentation to the London Junior Section of the Institute of British Foundrymen.

thickness and size of the casting. In practice, the sprayed articles are placed on racks, tiered above each other, and loaded into the drying house in batches by means of conveyor trucks. The drying house is usually heated by the waste heat from the muffle or furnace, and must maintain an even temperature of between 110 to 130 deg. C. It is also essential that the air be kept in circulation, this being done by a number of high-speed fans. Slow drying with stagnant air produces rust spots due to the action of the wet enamel in the cast iron, which spots show as defects in the enamel finish.

Fusing.

When these castings are properly dry, they are placed in the fusing muffle and fired for about 10 to 20 min. at a temperature of 740 deg. C. Furnaces may be oil, gas, coal or electrically fired. Oil and electric furnaces are to be preferred for reasons of cleanliness and easy operation, but usually the cost of electric power in this country is too high to make this a commercial proposition. The oil-fired furnace is the most popular, and will burn any good domestic fuel oil with a viscosity of between 70 to 100 deg. This furnace consists of a combustion chamber into which the atomised oil and air are injected, and a gas-tight muffle so arranged that the heat is distributed evenly on every side by means of flues and ports. The whole furnace is constructed of special firebricks, while the actual muffle walls are lined with such material as carborundum bricks. An average furnace measures about 12 ft. by 4 ft. by 3 ft., and will require about 150 tons of bricks and refractories.

The fuel oil is usually stored in a tank holding about 5 tons, and is pumped into a smaller overhead tank holding about 80 galls. by means of a small semi-rotary pump. From here it flows by gravity to a small pre-heating tank fixed to the side of the furnace, prior to being mixed with air and injected into the combustion chamber of the furnace.

A small contrivance is fitted in the oil line to cut off the oil should the air supply fail, as the injection of unatomised oil into the hot furnace might produce an explosive mixture. Also, it is not a pleasant job to remove oil from the motor and fan which would occur if the air supply failed. The quantity of oil used depends, of course, upon the size of the furnace and the number and nature of the loads fired. For a furnace measuring, say, 12 ft. by 4 ft. by 3 ft., about 4 to 5 galls. per hr. will be burned.

Handling Difficulties.

The charging of the furnace presents special difficulties, and to accomplish this speedily a double-charging fork runs on rails in front of the muffle door. The dried sprayed castings are placed on special heat-resisting bars of hanging hooks, taking care to support the casting firmly while allowing it to touch the bars or points in as few places as possible, since, as when spraying, each point of contact causes a blemish in the enamelled surface. When one fork is loaded the muffle door is opened by means of a remote control, either hand or electric, and the charge inserted in the muffle by means of a winding device. The fork is then lowered, leaving the charge and the heat-resisting bars inside the muffle. The fork is then withdrawn and the door closed. While this charge is being fired the other fork is charged in a similar manner ready to be charged as soon as the last batch of castings is ready. This is accomplished by winding the entire fork along the rails until it is exactly opposite the charging door.

Whenever possible each charge should consist of similar pieces of equal thickness, otherwise the thin sections will be fused before the thicker ones, resulting in the castings being either burnt or under-fired. Although it is possible to fire under-fired castings a second time, this is a wasteful method and means waste of both time, furnace space and labour. After a firing of about 15 min. the castings are withdrawn and removed from the charging fork by means of asbestos gloves and the result should be a perfect article to be passed forward to the erecting shop. From these few foregoing remarks it will be seen that the whole process is somewhat complicated, but, if every operation is carried out accurately and carefully, trouble should not occur, and the resulting article should be a casting covered with a highly-glazed coat of practically unchippable, rustless, porcelain enamel.

Catalogues Received.

Alloyed Pig-iron.—Messrs. Bradley & Foster, Limited, Darlaston Blast Furnaces, Darlaston, Staffs, have prepared an eight-page brochure specially to cater for recent developments in alloyed cast iron by way of providing suitable raw material. A feature is made of risks attendant on the addition of metals and alloys to the metal in the ladle, where the melting points of the additions are not materially lower than the liquid in which they are to be dissolved. Photomicrographs are reproduced showing cases where such defective work has arisen. Page 4 details a range of seven chromium-bearing pig-irons chosen with a view to maintaining low melting point, whilst page 5 lists a series of six nickeliferous pig-irons. Following these are detailed a nickel-chrome pig-iron having two silicon ranges. An interesting announcement appears on page 7, whereon is detailed Norskalloy, a natural, electric-furnace smelted pig-iron containing vanadium and titanium. The compiler has used a word in this section which we cordially dislike—"castability." The proper English word for this is "life." The last page is devoted to a pair of irons they make specially for manufacturers of "Silal" heat-resisting irons, cast in either sand moulds or chills. As this is a catalogue of serious worth, we strongly advise our readers to avail themselves of the offer of the company to supply copies gratis to them.

Foundry Tools.—Messrs. J. W. Jackman & Company, Limited, Blackfriars Road, Manchester, have issued a four-page leaflet which, in that small compass, is designed to contain something of interest to every ironfoundry. We appreciate how difficult this is, as the various foundries have such varied requirements. The object has been attained in this case by illustrating and describing a pneumatic jolt and lift moulding machine; the Vulcan volume-blast meter for controlling cupola operation; the Osborn type roll-over jolter (No. 401), and a simple hand-operated moulding machine of the press type. We congratulate the publicity department of this concern on its intelligent appreciation of what should be broadcast to the industry as a whole.

Coke.—Only recently we reviewed a batch of trade literature sent out by Priestman Collieries, Limited, of Milburn House, Newcastle-upon-Tyne, and commented that reference was made in one brochure to a second one dealing with beehive coke, adding that we failed to find this stressed in the companion booklet then available to us. It seems that our collection was incomplete, for we have now received a larger brochure, beautifully presented and excellently illustrated, which in 12 pages gives the foundryman full technical data about Garesfield beehive foundry coke, and shows something of the internal organisation which assures the regular maintenance of a high standard of production.

A receiving order has been made on debtor's petition in the case of Mr. W. B. George, metal broker, 21, Penwortham Road, Sanderstead, Surrey.

World's Output of Pig-Iron and Ferro-Alloys.

The subjoined table shows (in tons of 2,240 lbs.) the world's output of pig-iron and ferro-alloys. The table is reproduced from a Statistical Summary issued by the Imperial Institute.

Producing country.	1929.	1930.
	Tons.	Tons.
British Empire.		
United Kingdom	7,589,300	6,192,400
Union of South Africa	16,249	29,255
Canada	1,169,276	813,492
India	1,348,175	1,179,851
Australia	*	*
New Zelaand	4,393	8,075
Total	10,500,000	8,600,000
Foreign Countries.		
Austria	451,724	292,136
Belgium	3,976,715	3,349,264
Czecho-Slovakia	1,618,542	1,414,392
Finland	6,504	*
France—		
Saar	2,071,695	1,882,240
Other districts	10,200,075	9,876,608
Germany	13,030,356	9,541,298
Hungary	362,140	253,164
Italy	714,841	578,314
Yugoslavia	32,665	34,558
Luxemburg	2,860,195	2,434,666
Netherlands	249,768	268,411
Norway	150,972	142,549
Poland	694,389	470,399
Rumania	71,203	67,756
Russia†	3,954,300	5,011,000
Spain	687,448	591,621
Sweden	515,556	488,570
Mexico	59,279	56,913
United States	42,613,983	31,752,169
Brazil	*	*
China	*	*
Japan‡	1,490,906	1,630,013
Korea	153,058	148,987
Manchuria	289,512	*
Philippine Islands	200	200
Total	86,700,000	71,100,000
World's total	97,200,000	79,700,000

* Information not available.
† Years ended September 30.
‡ Including pig-iron produced at government and other steel works for conversion into steel.

Iron and Steel Output in March.

The National Federation of Iron and Steel Manufacturers report that there were 72 blast furnaces in operation at the end of March, a net increase of one since the beginning of the month, one furnace having ceased operations and two having been blown in. The production of pig-iron in March amounted to 335,600 tons, compared with 323,600 tons last February and 357,100 tons in March, 1931. The production included 65,800 tons of hematite, 133,000 tons of basic, 114,100 tons of foundry and 14,200 tons of forge iron.

The output of steel ingots and castings amounted to 462,800 tons, compared with 480,600 last February and 500,100 tons in March, 1931.

Direct Production of Steel.—Direct reduction of iron and other ores in a new type of electric furnace in the production of high-grade steels has recently been accomplished in America. The furnace is known as the Wiles hollow-electrode furnace, and the patents and furnace are owned by the Buffalo Furnace Corporation. In this process the ores are mixed in a finely-divided condition with suitable reducing agents, and are passed through the hollow electrode while the current is on, the reduction taking place as the material passes through the electrode.

A Modern Ingot Mould Foundry.

For the economic production of ingot mould castings the major problems to be solved are:—(1) The transport of the materials, both raw and during the stages of manufacture; (2) the rapid and economic confection of the moulds and cores; (3) the elimination of waste; (4) the rapid production of liquid metals at a reasonable cost, and (5) adequate drying facilities.

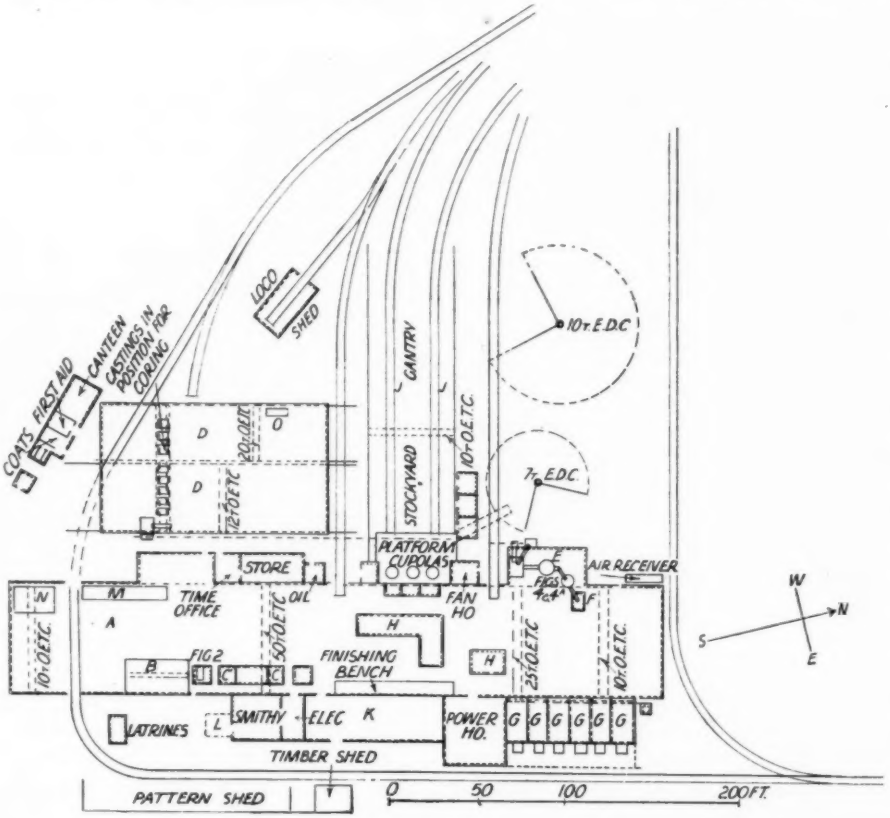


Fig. 1.—General Lay-out of the Fullwood Foundry, Mossend.

It was with these factors uppermost in our mind that we paid a visit to the works of the Fullwood Foundry Company, Limited, at Mossend, Scotland, and it is pleasing to note how the five factors have been fused into one whole with outstanding success. This plant was erected in 1915 as an ingot mould foundry, and within the last few years the plant has been improved and new machinery has been added to bring the whole works into line with the most modern foundry practice.

The methods employed can best be visualised by reference to the plan of the foundry (Fig. 1). The castings are stripped at A, the sand is reconditioned at B, whilst moulding is effected on the jar-ramming machines at C and C1. The casting and the core are transferred to the fettling shop D, where the core is removed and conveyed to E. Here it is treated and passed along to the jar-ramming machine at F. Cores and moulds are dried in the stoves G, assembled in the casting pits H, and after stripping the cycle is repeated.

Melting Plant and Raw Materials.

Ingot moulds have to be made from hematite iron, as most types have to conform to a specification that limits the sulphur and phosphorus content. Thus, supplies are mainly drawn from the West Coast of England blast furnaces, and brought into the sidings shown at J, unloaded by magnet, stocked and analysed before use. There are three 14-tons an hour cupolas of the solid bottom type, each possessing two charging doors for rapid filling. The cupola staging is open, as experience has shown that this gives immunity from gassing of the furnace operators. Great care is given to the weighing of iron, coke and limestone. Iron bricks are extensively used in position in front of the charging doors.

Blast for the three cupolas is provided by three electrically-driven fans, each directly connected to its own motor. Two of the motors are of 40 h.p., and one 50 h.p. The air piping is so arranged that any fan can be run in conjunction with any furnace. Pig-iron is loaded by magnet into boxes each carrying 8 tons, and after being weighed is lifted on to the cupola staging by a 10-ton electric crane spanning the stockyard, and should there be by any untoward circumstances a breakdown, a jib crane alongside the stockyard can feed an extension of the cupola staging. The metal is tapped in ladles of either the Collin or the Whiting type, suspended from one of four overhead electric cranes ranging from 10 tons to 50 tons capacity. Slag from the furnaces is economically dealt with, as an adjoining works is taking it for the reclamation of land. The melting coke ratio is of the order of 1 to 10, including bed charge, whilst we are satisfied that the refractory costs are reasonably low.

Moulding and Sand Preparation.

Patterns are made in a well-equipped shop indicated at K (Fig. 1). It is furnished with a Wadkin planer, and the usual machines necessary for making large patterns of a simple character. Another auxiliary shop L (Fig. 1) is devoted to the manufacture of the lugs. Bars of suitable length are charged into an oil-fired furnace outside the wall of the blacksmiths' shop, and pressed to the required shape in a horizontal air-operated press.

Sand from the knocked out boxes is transferred to the sand storage B (Fig. 1) by a crane-handled grab, where conveniently placed at its side is a supply of new Scottish rotten rock sand. The sand storage is somewhat elevated, which makes the feeding of an air-vibrating 4 ft. by 2 ft. riddle by a short conveyor belt an easy matter. The riddle being slightly canted, overmatter is discharged to a shute. The riddled sand is received by a crane-handled bottom-discharging bucket. This plant is shown at Fig. 2. The pattern of an ingot mould and the moulding box are placed on one of two Tabor jar-ramming machines C or C1 (Fig. 1). This particular machine C was supplied by Macnab & Company, Limited, seventeen years ago, and is probably the largest in the country. This 32-in. machine can handle moulds up to 16 tons at 80 lbs. pressure and 26 tons at 110 lbs. Its table measures 10 ft. by 7 ft., and its record is definitely noteworthy. The second machine C1 (Fig. 1) has a 20-in. dia. ram, and is capable of dealing with loads of 10 tons at 110 lbs. pressure.

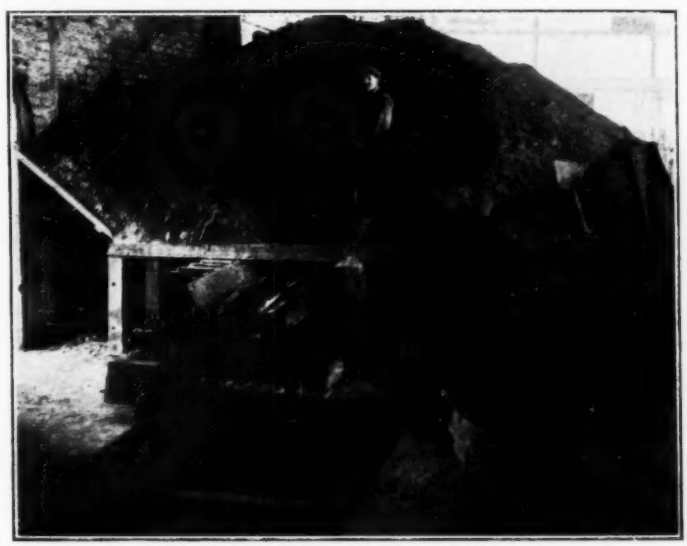


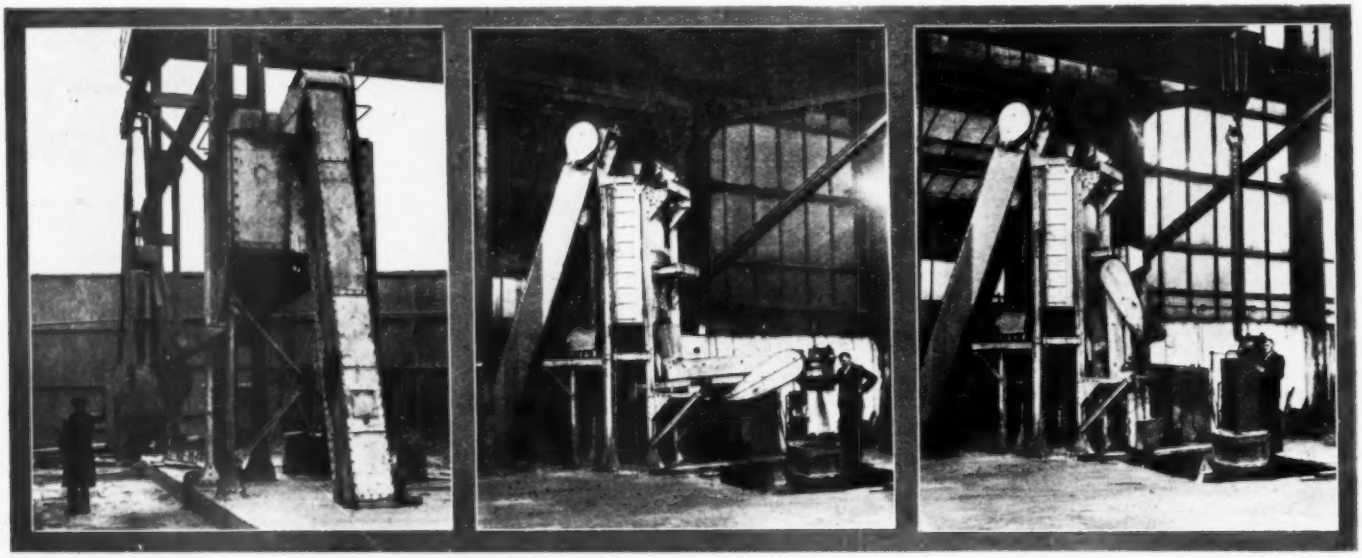
Fig. 2.—Moulding Sand Preparing Plant.

Coremaking.

To receive a proper appreciation of this section one must start at the fettling shop, where the cores are removed by using pneumatic tools.

The castings are placed on a gantry, and as the sand is removed it falls through gratings of 1½ in. mesh running on either side. Beneath these are belt conveyors feeding into the boot hopper, where a bucket elevator hoists the sand to an overhead storage bin (Fig. 3). From this supplies are drawn off into a bottom-opening hopper suspended on a monorail. Ball bearings and balance allow it to travel the length of the shop with a minimum of effort, while a ratchet arrangement provides an excellently controlled method for gradual emptying. Arriving at a point opposite E, the contents of the suspended hopper are discharged through a 1-in. mesh wire sieve fastened on the top of an elevator boot. At the left of this sieve is a trap door, which enables the operator to see within the foundry and to set in operation a bucket elevator for filling a large storage tank. At the top of this elevator and at a number of other points in the system, the stream of sand encounters a strong air exhaust for ridding the sand of its fines. This exhaust delivers the fines through a water mist to a settling tank, which is periodically cleaned out. The storage bin feeds a Simpson mixer having an 8 cwt. capacity. New sand is fed under controlled conditions. The water to be added is contained in a tank surmounted over the mill and fitted with a syphon action so that this, too, is under complete control. The only variable now left to the mercy of the operator is the time of milling, and the management have presently under consideration the fitting of a device to control the milling time. Normally, the mill discharges through a disintegrator into the boot of the elevator shown at Figs. 4 and 4A, though, when engaged on loam mixing, arrangements are incorporated for an auxiliary discharge in another position. The bucket elevator fills the storage tank shown at Figs. 4 and 4A. This tank is provided with a rotatable base, which rotating against a cutter directs a steady stream of sand at any required quantity from the tank on to a short belt conveyor, whence it is conveyed to a hood above the core box. Suitable guides direct the sand into any position in the core box, which rests on the table of a 20-in. Tabor jar-ramming machine F (Fig. 1). This machine can handle a maximum load of 10 tons at 110 lbs. pressure, and the table measures 6 ft. by 4 ft. The core arbors now used are of cast steel, as the breakage of cast-iron grids caused considerable wastage. The whole of this core sand collection, preparation and delivery to the core box is the outcome of close collaboration between the suppliers, the August's Muffle Furnaces, Limited, Thorn Tree Works, Halifax, and the management of the Fullwood Foundry Company, Limited.

Fig. 3.—Core Sand Elevator Plant.



Figs. 4 and 4A.—Core Sand Preparing Plant.

Moulds and Core Drying.

For the drying of the moulds and cores a battery of six stoves G (Fig. 1) of graduated dimensions is available. They are charged by means of one-piece steel-built bogies moving on roller bearings. They are run in and withdrawn by means of an overhead crane. Just at the back of the doors, which are well insulated, are exhaust flues leading to the smoke stack. Drying is carried out in an external lean-to and the fuel used is low-grade coal. Heat enters the oven, first into a distributing chamber and from thence through an area of pigeon holes along the back wall. The efficiency of the stoves can be gauged by the fact that the largest moulds can be dried overnight.

Stands.

Ingot mould bottom plates are cast at M (Fig. 1). The moulds are prepared at the place of casting, while the top parts are made ready at N (Fig. 1) and transferred to M (Fig. 1), where the complete box is closed ready for casting.

Sand Cleaning.

There is in constant use, though not incorporated in the line of sand movement, a sand-cleaning plant O (Fig. 1), by the Rapid Magnetting Machine Company, Limited. The smallest iron shot recovered is packed in wooden boxes and used in the cupola. This method is also used by Alfred Herbert, Limited, of Coventry, but they use canisters in place of wood boxes.

Main Buildings.

The main buildings are spacious, ample in headroom, and well lighted, and the conditions generally for carrying out work are very good. The foundry building is in one span of 60 ft., 375 ft. long, the height from floor level to eaves is 39 ft., and to crane rail 28 ft. There are also lean-to buildings along the sides, in which are housed the various departments outside of moulding and casting. The building is well lighted by side glazing, and artificial lighting is supplied by high-power electric lamps on walls. This is

Fig. 5.—General View Inside the Foundry.

supplemented by lamps hanging from the underside of overhead travelling cranes, and this system of lighting from the cranes enables the work to be carried out immediately under good lighting conditions. In convenient positions, sections of the foundry floor are laid with cement or concrete slabs, which can readily be swept, thereby helping to keep the floor tidy.

The paths round the foundry and those leading to various out-buildings are laid with concrete slabs manufactured by the company, which all tends to keep the works in a smart, tidy condition, as well as providing better facilities for the workers, in contrast to many foundries where these do not exist.

The fettling shop is in two spans of 40 ft. 6 in. and 33 ft. and is 130 ft. long. The height from floor level to eaves is 32 ft. 6 in. and to crane rail 25 ft. The ends of the shop and one side are open, and this arrangement tends to keep the air much freer of dust than would be the case in an entirely closed building. The whole roof is glazed, and, in consequence of this, and the open nature of the building, the lighting is excellent. The artificial lighting is on the same lines as that in the foundry. The overhead crane gantries are carried past the building at either end and over sidings running along the ends of the shop. This arrangement makes the transfer of castings from the foundry to the fettling shop and the delivery of the finished article into wagons for despatch a convenient and expeditious operation. The whole floor is laid with oak beams, making it solid to work on and easily kept clean.

Fig. 6.—General View of the Foundry from the South.

Stock Yard.

The gantry over the stock yard is of 50 ft. span, 200 ft. long, and 33 ft. 6 in. from floor level to crane rail. The floor on which the pig-iron is stored under the gantry is laid with wooden sleepers, which allows of it being easily kept clean, and also prevents the iron getting buried in the ground. There are two sidings running the whole length of the gantry, which gives ample space and an expeditious way of discharging pig-iron, etc., by overhead crane.

Other Buildings.

Apart from the foundry but close to it are the canteen, a cloakroom fitted with wash-hand basins, and a first-aid room fitted with all the necessary appliances for dealing with cases of accidents. These are all housed in one brick building of substantial character. The time office is situated in one of the lean-to buildings, from which the workers enter directly into the foundry. On a branch from one of the works' sidings, in a convenient position, is the shed for housing the works locomotive. The shed is a substantial brick building having water supply tank, inspection pit, etc., for the locomotive. The general offices and private rooms are situated at the entrance to the works, and at some little distance from the foundry proper, the upper portion of the building containing two houses, occupied by foremen in the employment of the company.

Fig. 7.—General View of the Fullwood Foundry, showing in the foreground Accommodation Sidings and Arrangement of Works Siding.

Sidings.

The works are excellently situated with regard to railway facilities, as the L.M.S. Glasgow to Edinburgh main line passes just at the south end of the foundry. Adequate accommodation sidings in the company's ground connect with the main line, and from these very ample works sidings branch off to the different parts of the works, making the delivery of raw materials to the various departments of the works extremely convenient, and the loading and marshalling of out-going traffic an expeditious matter. At the end of the accommodation sidings is a 50 tons weighbridge, on which all incoming and outgoing traffic is weighed.

In conclusion, we desire to express our sincere thanks to the directors and to the foundry manager for the courtesies extended to us and for the help they have given in the preparation of this article.

An Old-Established Iron Foundry.

In a letter to the daily Press, Mr. James Downs, chairman of Messrs. Rose, Downs & Thompson, Limited, ironfounders, of Hull, states that their business was founded in 1777. For a long time it was the only ironfoundry between the east coast of Yorkshire and York itself.

Some years ago the firm made inquiries about its position among the oldest engineering concerns in the country, and, so far as could be ascertained, no other had such an unbroken succession of partnerships.

Thus there may be engineering establishments still in existence which were founded earlier, but they have been bought and sold and have changed hands in various directions. Since 1777 the business of Rose, Downs & Thompson, Limited, has been continued without a break, and handed on from father to son or from partner to partner's representatives.

Nature Intervenes.

The North Lonsdale Iron & Steel Company, of Ulverston, came prominently into the news last week, as for the first time for eighteen years they were able to consign a cargo of 250 tons of pig-iron from their pier at Ulverston. The cessation of seaborne traffic for this long period has been entirely due to the shifting sands having since 1914 blocked up the channels. The first ship to enter was the motor ship "Warita," which took the consignment to Messrs. J. Summers & Sons, of Harwarden Bridge Steelworks, Chester. It is confidently expected that the reopening of the channel will bring in its train a period of prosperity for the local ironworks.

The 10,000-kw. turbo-alternator which the British Thomson-Houston Company, Limited, manufactured at their Rugby works for the Detroit Edison Company of the United States of America, to operate at the highest steam temperature yet attempted in turbine practice—namely 1,000 deg. Fah.—was put into commission in Detroit during the past year, and has now been operating satisfactorily for some months at full temperature and load.

Italian Steel Foundry Practice.*

By Dr. Ing. Guido Vanzetti.

The story is told that when Henry IV of France made his entry into the City of Rouen, the Governor, coming out to meet him, began his welcome with the following words: "Sire, we should have liked to fire a salute of guns to celebrate this memorable occasion, but several reasons prevented us from doing so. The first is that we have no guns; the second . . ." "Well, we will dispense with the others," broke in Henry IV, "the first is enough."

When I was invited to give a lecture before the London Branch and Lancashire Branch of the Institute of British Foundrymen, I must confess that with so many reasons which tended to dissuade me from accepting, the story of Henry IV crossed my mind. My limited knowledge of English, my inexperience in the matter of lectures, the lack of time in which to make a proper preparation which would allow me to present a Paper of a purely technical character, were all causes one of which alone would have been enough to make me give up the idea. However, there was then one motive which made me change my mind. The enthusiasm with which our British friends expressed themselves with regard to the visit to our country on the occasion of the Foundry Congress caused me to think that I could do like Mahomet, who went to the mountain since the mountain would not come to him, and I should be able to tell my British friends who did not take part in the Congress in Italy what they would have seen had they made the journey and been present.

Moreover, I think that even for those who were at the last Congress I can bring some additional information. They saw our sun, our sky, our mountains, our sea. They saw the masterpieces of Italian art; they kissed the Pope's ring; they heard the words of Mussolini. Perhaps that which they saw least of in Italy were the foundries. Now it is I who will try to outline the conditions under which the foundry industry is being carried on in Italy; I shall limit myself to the steel foundries, in which I am particularly interested.

An Ancient Industry.

Until a few years ago the Italian steel industry had the position in the world of a fallen noble—really a fallen noble and not a baby in swaddling clothes, because, as a matter of fact, in order to give the history of the iron industry in Italy it would be necessary to go back over two thousand years. It is, in fact, asserted that, during the war of Troy, the arms were made of iron obtained from ore from the island of Elba. But during the course of time it happened that our country had alternate periods of great splendour and decadence, and during the latter many traces of past civilisation disappeared. In fact, it happens that even to-day things are invented which have been merely forgotten (such as anchor ball-bearings and bronze taps as seen on the ships of Caligola found in the lake of Nemi). As far as Italy is concerned, we can begin to speak of the steel industry from 1870, when in place of the first Bessemer already at work for some years past, we installed the first open-hearth furnace.

Whilst the production of pig-iron underwent a stoppage towards 1890 on account of foreign competition and the insufficient yield of the charcoal blast furnaces, the steel industry developed rapidly precisely by reason of the installations of open-hearths.

Steel Production.

The production of steel ingots and castings rose from 4,000 tons per annum during the period 1881-85 to 123,000 tons in 1901 and 714,000 tons in 1910. In this latter period the first "Stassano" electric furnaces made their appearance. They were, in the first place, meant for the direct conversion of iron ore into steel and to eliminate the passages through the pig-iron stage, which seemed a technical absurdity. The extension of the electric furnace for the production of steel in Italy had its greatest impulse during the war period on account of the absence of coal in our country and the difficulties of obtaining supplies in war-time. The total production of steel in Italy reached its highest point in 1929 and exceeded 2,000,000 tons.

From authentic figures it is possible to follow the course of the production of steel *castings* from 1904 onwards. The first maximum point coincided with the period of the war in Lybia, whereas the absolute maximum was reached in 1918; this high point was never again reached, not even in 1929, which was the record year for Italy for the total production of steel and of pig-iron.

Table I.—*Percentage of World Production of Electric Steel.*

United States	53.6
Italy	16.2
Germany	10.9
France	7.2
Great Britain	5.6
Sweden	3.7
Others	2.8

Of late years, the level of the annual production of steel castings was slightly more than 50,000 tons. There was a slight increase in 1925 and 1930, although in the latter year the large steelworks and rolling mills, etc., were already passing through a crisis. This increase was essentially due to large orders for the State railways which, together with those for the Royal Navy, take up the greater part of the production of steel castings. In 1931 it was inevitable that this industry also should suffer a contraction, however, within relatively modest limits.

Plant Available.

On examining the capacity of the plants for the production of steel in Italy, it is difficult to make a clear distinction between those relating to ingots and those for castings. There are, in all, 49 steelworks in Italy, ten of which produce castings exclusively. But these latter have a negligible capacity and a very small production of castings as compared with the capacity and production of castings of the large steelworks. There are, therefore, about a score of foundries in Italy which produce steel castings.

There are, for the total production of steel, 122 open-hearth furnaces, with an aggregate capacity of 3,844 tons (83 per cent. of the total capacity), 96 electric furnaces with 744 tons capacity (16 per cent. of total), and 8 converters with a capacity of 44 tons (1 per cent. of total). An idea of the development of the electric furnace in Italy may be gained from the fact that in 1925, whereas the United States were at the head of the list as regards total steel production (about 50 per cent. of world's output), Italy occupied the eighth place (about 2 per cent. of the world production); in the same year, for the manufacture of steel by the electric furnace, the United States were again at the head of the list and Italy was second. Table I shows the relative production of the various countries. Thus, whilst to-day Italy holds the second position in the world for the production of electric steel, it has the first place when comparing production with the relative total.

If we now turn to the particular sphere of steel castings, the percentage of electric steel in Italy is so large that it may be said that to-day in my country, almost all castings are made from electric steel. The types of electric furnaces mostly in use in Italy are "Heroults," then follow "Fiats," "Electrometals," the old "Stassanos," the "Tagliaferris" and the "Brown-Boveris."

Superiority of the Electric Furnace.

I will now attempt to demonstrate the reasons why, all over the world and especially in Italy, the electric-furnace process has developed so extensively. A first consideration of a general nature could be that the electric furnace made its appearance after the converter, and the sole fact that this latter has been supplanted by the former would go to show that those who have had the possibility of making a comparison direct between the two systems, have had no hesitation in making their choice, whilst those who have remained faithful to the converter practically never had a chance of making the comparison.

On the other hand, I know perfectly well that there are eminent founders, many of whom have not forsaken the old converter and who may answer by telling me that during these several years of experience, also under the pressure of the competition of the electric furnace, they have been able to improve their system of manufacture in such a way as to obtain results, of which there was not the slightest conception at the time when the new process by electric furnace began to replace the converter; and the steel castings turned out by the British foundries would not have the fame of being among the best in the world had they not achieved this point of perfection in the use of the converter. At the same time, I do not overlook how adept you are in the use of the electric furnace; you must know that the person who came into our own particular foundry to install our "Electrometals" and to instruct us in its running was actually an Englishman, Mr. V. C. Faulkner, your Past-President.

Economic Advantages.

From the economic point of view, the electric furnace found its ideal sphere and took precedence over the other systems, principally by reason of the fact that it allows the utilisation of hydro-electrical energy, in which Italy is rich, in place of coal which Italy has to import from abroad. As compared with the converter, it has the special advantage, so far as we are concerned, of being an all-scrap process.

Examination of this characteristic of the Italian steel industry and its various causes would lead me away from my subject, because it would be necessary, from a more general point of view, to consider the conditions under which the main Italian steel industry is carried on rather than the steel foundry. The relative scarcity of iron ore in Italy, the absence of coal, the greater consumption of fuel in a complete cycle of operations starting from the iron ore, and the cost of transport, are all points which influenced the disappearance of the Bessemer from the steelworks in favour of the open hearth particularly for the production of ingots, and in favour of the electric furnace for the production of castings. It must also be borne in mind that whereas pig-iron is protected by an import duty (which has a bearing on the prices of the national product) scrap is free from duty.

Cost of Electricity.

The cost of electrical energy is very variable from one district to another. Of course, along the Alps and along the Apennines, in the neighbourhood of the sources of energy, it is lowest. There are a few works for the produc-

* A Paper presented to the London and Lancashire Sections of the Institute of British Foundrymen, Mr. H. G. Sommerfield and Mr. Roy Stubbs presiding at the two meetings. Dr. Vanzetti is on the directorate of the Fonderia Milanesi di Acciaco Vanzetti, of Milan.

tion of ferro-alloys which consume what is called seasonal power, and for this they pay only from 2 to 3 centesimi and even less per kilowatt-hour (about one-tenth of a penny). In Milan the cost is pretty high. The terms of the contract between my foundry and the suppliers of power enunciate that the power consumed must be charged at the end of each month and that two separate invoices are to be made out, one for demand charge and one for energy charge. The demand charge relates to the thirty minutes of maximum demand during the month, costing 30 lire per kw.-hr. (8s. 6d. to 9s.), whilst the energy charge is rated at about 7 centesimi per kw.-hr. consumption during the summer and 13 centesimi during the winter (respectively about one farthing and one half-penny). The winter rate lasts about four months, November to February, and the summer tariff is applied for the rest of the year. Taking into consideration both the demand and energy charge, this tariff works out at an annual average charge or cost of almost 18 centesimi (just under three farthings).

Raw Material Costs.

If we consider that ordinary steel scrap (second grade) costs about 180 lire (£2 12s.) per ton, delivered at our works, coal for the open hearth about 130 lire (£1 17s.) per ton, coke about 190 lire (£2 14s.) and hematite pig-iron about 400 lire (about £5 18s.) and without going deeply into a detailed analysis of cost, it will be seen that the conditions in our country with regard to supplies of raw material are very much different from those obtaining elsewhere and this is sufficient to justify a different orientation being taken in the matter of manufacturing processes.

A Comparison with the Bessemer.

As regards thermal yield, although that of the converter is high, it is however understood that it is below that of the electric furnace when one takes into consideration that over 30 per cent. (according to Osann) of the heat produced by the oxidation of the bath and by the formation of slag is lost by heating the nitrogen blown into the converter with the air. The possibility might perhaps be studied, in the case of a very low price for the oxygen, meaning where it can be obtained as a by-product in the manufacture of nitrate products, of blowing oxygen alone into the converter.

If we take into consideration the melting loss, the converter has under this heading, a great disadvantage in comparison with the other processes. According to Lister, the loss is between 20 and 30 per cent. comprising both cupola and converter losses. According to our experience, out of 100 kgs. of metal charged in the cupola, about 95 kgs. of molten iron are obtained, and from the converter we could only with difficulty obtain about 75 kgs. of steel.

The heating of the bath is produced by a very costly fuel, *i.e.*, pig-iron, comprising Fe, C, Si, Mn, particularly Si and Mn whose presence in the iron increases its cost.

Of course, much better results can be achieved. Some assert that, under favourable conditions, the loss, comprising cupola and converter, can be reduced to about 12 per cent. I think, however, that these are exceptionally favourable results and only obtainable in isolated cases. Just as when Americans state that with their acid-lined electric furnaces they have a power consumption of 500 kw.-hr. per ton of produced metal, I think they are not speaking of a long period of work but rather of just a snap test, during which none of those incidents has occurred which have called for a calculation of a supplementary consumption of from 20 to 25 per cent. In any case, melting loss is undoubtedly lower with the electric furnace, being from 3 to 5 per cent.

If we take into consideration exclusively the running of the foundry and the adaptability of the furnace to the quantity requirements of the production, it will be seen that actually the small converter has a superiority over the other systems. The possibility of obtaining small quantities of steel at short intervals of time and being in a position to stop when required, is the ideal condition for a foundry. With two cupolas, each with an output capacity of about 6 tons per hr. of iron, and two converters of 1 ton each, it is possible to obtain the smallest castings, in competition with malleable iron, up to 30 tons. Further, the possibility of rapid production by the converter has the advantage of being able to reduce the furnace capacity, installation and running costs. From this point of view the open hearth is the worst adapted for a foundry of the jobbing-work type where castings are produced in all sizes and in all quantities.

The Position of the Open Hearth.

The possibilities of the open hearth for such foundries are limited by various considerations, which originate from the fact that an operation lasts several hours, and that it is necessary to employ quickly at the moment of the pouring a quantity of metal which must be uniform and equivalent to the capacity of the furnace. It is not easy to bott up the furnace before having completely emptied it, even in the case of an acid furnace, and it is well-nigh impossible in the case of a basic furnace. Really, only tilting open hearths give the possibility of drawing off just the required quantity of metal in a ladle, but the practical realisation of this method presents some difficulties on account of the cost of installation and the task of procuring good joints at the gas and air ports.

The fact of having to utilise quickly at a given moment the whole of the steel produced is a serious inconvenience, because, as it cannot be raised to a very high temperature by the open hearth, it cannot be long kept in the ladle, nor is it always possible to utilise it by a special organisation of quick distribution with shanks. From this we gather that where there is not a considerable tonnage of large castings to be poured the capacity of the open hearth should be rather small (from 3 to 8 tons). And as the open hearth, in order to be operated under good working conditions, should be continuous, the capacity of the furnace must be limited to the *minimum* output of castings; other furnaces (converters or electric furnaces) for the purpose will produce any variable supplementary tonnage required. However, in such conditions the consumption of fuel is high, as, for small open hearths, the quantity of coal loaded into the gas-producer reached 40 to 50 per cent. of the weight of the metal produced.

As regards cost of installation for a certain capacity, the electric furnace (furnace, transformers, etc.) varies between one-half and two-thirds (according to Levasseur) of the cost of installation of an open-hearth (furnace, gas-producer, chimney, foundations, etc.).

The electric furnace, although it may not have the elasticity of running of the converter, can be very well adapted to any production both as regards quantity and quality. In fact, the electric furnace is very adaptable to any quality of metal. A heat of ordinary carbon steel can be followed by a white iron or grey iron or special steel heat. It can also be run more economically than the converter, provided the installation in connection with the capacity of the furnace and the contract for electric power have been well studied and managed.

Acid or Basic?

The choice of the acid or basic furnace will depend on the type of product which it is required to obtain. In any case it may be observed that for any quality of final product, the purer the raw material is and consequently the more costly, the less time the operations take and the less current is consumed and the lower is the cost of refractories. It is therefore a case of making a compromise between the two tendencies. Even in the case where the scrap is inferior it may be necessary to use the basic furnace for such scrap, also it might be advisable to use a small acid furnace for remelting domestic scrap which, having been obtained previously from a basic furnace is, of course, of good quality. This is the system which we are now applying in our own foundry. The choice of the capacity of the furnace is of great importance with regard to the rational running of an electric furnace.

Choice of Electric Furnace.

Electric furnaces for foundries are generally of a capacity between ½ ton and 6 tons. Within the limits allowed by production requirements, it is advisable to adhere to small units. It is better eventually to run sometimes with the furnace overcharged rather than under-burdened. Although on the one hand the large furnace offers a better utilisation of heat, taking everything into account the small one can be run more economically; it will require a smaller quantity of maximum demand power, thus giving the possibility of obtaining better contract terms from the supplier; it requires less labour; it works more rapidly with small lots, adapting itself better to foundry requirements and approaching more in this sense the working of the converter. Floor space, cost of cranes, etc., all the accessory equipment for furnaces and the number of boxes employed are all points in favour of the electric furnace of the small-capacity type.

Even the running of the electric furnace, in order to be carried out under the best conditions, should be continuous. But of course these conditions depend on the contract for power. In cases where it is possible to have power at special rates during the slack periods of one or two hours in the day, it would be well to examine the possibility of running intermittently, the use of a basic or acid lining, seeing that it entails a more or less longer duration of the manufacturing process, and the advantage of running the duplex system. In this case, during the stoppage period, having charged the furnace immediately after the last heat, it would pay to keep the furnace hot by an oil burner placed at one of the doors. In our own foundry we have found that we can more simply make the charge of scrap and hermetically seal all the apertures of the furnace, doors and around the electrodes, with clay, in such a manner that all the heat of the lining is diffused in the charge, diminishing the loss by radiation, which is proportional to the fourth power of the difference of the temperature between the outside and the inside.

Another very important point of view in the comparison between the various systems of manufacture of steel for castings is that of the examination of the product—its chemical and physical properties or its metallographical and foundry properties.

The mechanical properties of electric steel are, without doubt, the best in regard to the dynamic and static tests. When we take into consideration formulæ, as for instance, tensile strength plus twice the elongation percentage, by which steels are often judged, the highest points are reached in the case of electric steels on account of their purity, which can approximate to that of crucible steel. It is evident that it is insufficient for a steel to be produced in an electric furnace in order that it should be of superior quality. It must also have been properly prepared, but this not invariably the case. On account of the flexibility of the electric furnace, in some cases it seems to have been installed because it appeared to be easy to run in a foundry, and without any of the principles of metallurgy being applied by inexperienced founders and without laboratory control. Lister says that the best electric steel is almost equal in quality to the best acid open-hearth and much superior to basic, but that bad electric steel is much worse than the worst products of either.

(*To be concluded.*)

Improved Lighting as an Aid to Industrial Efficiency.*

By H. Lingard (Engineer of the Lighting Service Bureau of the Electric Lamp Manufacturers' Association of Great Britain, Limited).

Artificial light of some sort is obviously necessary in every industrial establishment, for even where factories and other buildings have been designed to make the fullest use of natural light, there are some 200 to 250 hrs. per annum during which work is in progress when but little or no natural light is available. In the majority of cases artificial light is required during a larger number of hours owing to inadequate window area or external obstructions to daylight in the form of neighbouring buildings, fog, dark cloud, etc. There are, in fact, many cases where part at least of the artificial lighting system should be in use throughout each day. Since artificial lighting is thus found to be necessary during a considerable proportion of the annual working hours of the great majority of industries in this country, the effects of the highly diverse lighting conditions encountered in factories are important and must be studied if the best conditions for a given type of work are to be provided. For the purpose of outlining these effects, the term "good lighting" is used to signify lighting conditions which are adequate on the score of the quantity of light provided and a high standard of quality. "Bad lighting," on the other hand, assumes inadequate quantity and a poor standard of quality.

Effective industrial lighting is naturally of quite recent origin and since the beginning of this century its theoretical development has been exceptionally rapid, but its application, unfortunately, all too slow. Due to intensive commercial research, the engineer can to-day produce with accuracy almost any desired lighting conditions, and were this faculty taken advantage of by industrial executives with a view to providing good lighting in all industries, there is no doubt that the ultimate effect of such a step would be beneficial to everybody concerned.

Existing Lighting Conditions.

Two or three years ago the Electric Lamp Manufacturers' Association Lighting Service Bureau conducted an extensive investigation into the lighting conditions in the engineering industry, and it was found that only 30 per cent. of the factories investigated were employing modern lighting equipment, and of even that 30 per cent. only half had lighting which could be classified as good. The diagrams, Figs. 1 and 2, show the result obtained from the analysis of this survey, and it can be argued from the general experience of the problem that similar conditions exist in almost every other industry.

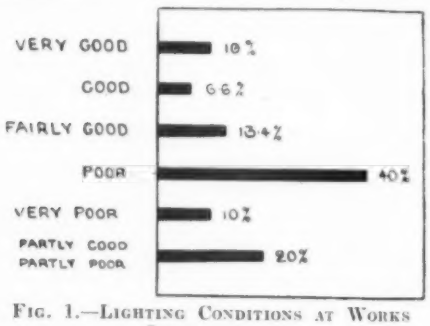


Fig. 1.—Lighting Conditions at Works Investigated.

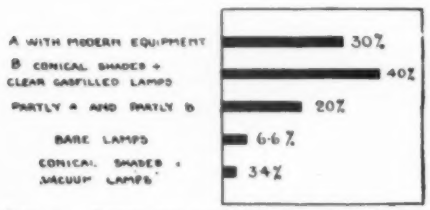


Fig. 2.—Incidence of Lighting Equipment in Works.

These unsatisfactory conditions seriously hamper, and even threaten, the almost traditional superiority of British productions, and a recent report of H.M. Chief Inspector of Factories cited a case where an operative was expected to work to one ten-thousandth of an inch under quite inadequate illumination, the direct loss due to the spoiling of one piece of material being in the region of £200. The false economy in failing to provide adequate lighting for such work is self-evident. It is a surprise to many to learn that there are still works employing flame sources as illuminants, while in innumerable cases entirely inadequate systems of lighting continue to serve year in and year out, either due to ignorance or a false conception of economy.

The drop-pendant system of lighting in which the lamp is suspended on a long flexible cable over the work came into being with the early carbon electric lamp, which was such a poor light source that it had to be in close proximity to the working plane, otherwise no light was available. It is this drop-pendant system equipped with the glaring modern lamp that is responsible for so much of the bad industrial lighting to-day; the new lamps have gone into the old equipment, and the result is as one might expect, a bad clash between the modern and the antiquated.

Lighting has an important bearing on industrial accidents, since many of these accidents are undoubtedly due to faulty vision. From the Home Office Reports dealing with industrial accidents it is evident that the accident rate is considerably higher during the dark winter months than during the summer. The direct cost of accidents in compensation paid annually has reached an enormous figure. In 1928 it was £6,000,000, but the indirect costs, such as loss of time, failure to complete contracts in a specified time, and similar effects must be far in excess of this figure. Good artificial lighting undoubtedly goes far in the direction of the reduction of accidents and their inherent costs.

Productive Value of Good Lighting.

The importance of good lighting in a factory from an economic point of view cannot be too highly emphasised, and it is usually from the standpoint of economies that industrial lighting is improved. Correct lighting reduces spoilage, improve the quality of the product, and brings about a marked improvement in the hygienic conditions of any factory, while even more important from the point of view of the management, the total output is substantially increased when a good lighting system replaces a poor one.

Lighting Faults.

Good industrial lighting can be achieved only through a clear understanding of the more important contributory causes of bad lighting. On analysis the principal industrial lighting faults are comparatively few but commonly encountered, and only the most advanced installations are entirely free from their harmful effect.

Fig. 3.—Example of Uniform Illumination in a Foundry, provided by Concentrating Reflectors of High Power installed above the Crane. Note the Beneficial Effects of Light Coloured Walls.

Glare.—Glare, an elusive, but all too common lighting fault, has been defined as the effect upon the eye of excessive contrasts of brightness. In industry, it is to some extent the outcome of the indiscriminate use of modern lamps with high filament temperatures, the brightness of which is extremely uncomfortable to the eye. Glare hinders vision and is a menace to the eyes, inasmuch as the sustained effect results in headaches, discomforts and allied nervous ills which react so detrimentally upon operatives, not only from the point of view of absenteeism, but from the standpoint of efficiency during the working day.

The effect to which glare hinders vision is easily demonstrated by means of a clear lamp switched on and off in the vicinity of a lettered card. This experiment demonstrates immediately how the glaring light makes the card appear to become dark and thereby reduces the value of the illumination which is provided. It should never be forgotten that illumination is

* From a Paper on "Industrial Lighting" read on April 4, before the Society of Engineers in London.

the ultimate aim of any lighting system, and, accordingly, the light should be directed to the work and not to the eye of the worker. This maxim of light on the object and not on the eye applies to all fields of lighting practice.

The retention of obsolete drop-pendant systems of lighting is the chief cause of glare in industry, and even when obscured lamps are used it is necessary to avoid a system of mounting which brings the lamp so close to the eyes. In certain industries, another form of glare, commonly called "reflected glare" occurs. This is due either to the raw or the finished material reflecting the images of lighting equipment in a specular manner. This form of glare is particularly insidious, as the eye is unprotected from light coming in an upward direction. Nature has evolved the brow to protect the eye against the brilliancy of the sun, but there is no such protection for upward light. Reflected glare can be minimised by using a diffusing form of light source, such as the industrial diffusing unit or by changing the relative position of the workman and the light source.

Inadequacy of Illumination.—Inadequate illumination is a problem concerned not only with the average illumination of the working plane, but with the requirements of individual machines, groups of machines, and special processes in certain industries. Gloomy surroundings have a profound psychological effect on the workers and are a handicap on the maintenance of good discipline and cheerful activity. It is curious to note in passing that gloom, meaning inadequacy of illumination, has come to mean a state of mental depression thus showing how intimately illumination is associated with human moods.

Shadows.—Differences in brightness are essential in estimating the shape of objects and may assist in the discrimination of detail. This does not imply that dense shadows throughout the shop are of the least value, for, on the contrary, they may be the direct cause of accidents. Diffused general lighting is essential for the majority of industrial interiors, but since this lighting is essentially direct in character and not shadowless in the way that indirect lighting is shadowless, the relief effect of shadows on the work is soft and luminous, but not so sharp and dense as to enable any confusion of the object with its shadow. Heavy shadows thrown across gangways are a fruitful source of accidents, for under such conditions obstacles may be easily mistaken for shadows. Even in those industrial operations, such as fine assembly, where high-intensity local lighting is essential at certain points, the shop should receive a reasonable level of illumination from an overhead system to avoid excessive shadow contrasts, which would otherwise be harmful.

Maintenance.—The maintenance of industrial lighting systems is for some reason rarely conducted on a systematic basis. It is, indeed, surprising how few factories have well-supervised and well-planned systems for cleaning lamps, reflectors and the lighting system in general. A recent survey of the prevailing conditions indicated that only 20 per cent. of the equipment could be considered clean, and therefore operating at its maximum efficiency. It does not appear to be realised to what an extent dirt and dust reduce the illumination available from any lighting system. Every factory should have a regular and definite system of maintenance, and in many instances a maintenance-record sheet will prove a great help in making certain that the lighting system is kept up to a high standard of efficiency. In offices, stores, machine shops, etc., readings of illumination should be taken for record purposes by means of a simple portable photometer, a number of forms of which are now available. These instruments are easy to operate and make the measurement of illumination little more difficult than the measure of air temperature.

Fig. 4.—Foundry Lighting by a Well-Planned System of Standard Dispersive Reflectors. Facilitates Vision and Reduces the Accident Risk.

Electric Lamps.—The most important element in any lighting system is undoubtedly the light source. It is the rapid development of electric lamps that has enabled industrial lighting, as it is known to-day, to be available at all.

The false economy of installing lamps of doubtful origin for industrial lighting cannot be too highly emphasised since these lamps, even if only a little less efficient than reputable lamps, will result in considerably heavier electricity bills or alternatively a reduction in illumination which, in most industries, would be disastrous, as the lighting is at present far below minimum recommendations.

For operations involving colour discrimination, the use of the daylight-blue gas-filled lamp is to be recommended, as it obviates the distortion of the true colours which occurs when the ordinary lamp is employed. The selectively tinted blue glass bulb of the daylight lamp filters out the excess red rays, so that the light emitted approximates to that of daylight. Due consideration must be given to the fact that in the filtration for colour correction the blue glass absorbs some of the radiant energy, so that in order to obtain an adequate illumination the wattage of the daylight lamp employed must be substantially higher than that of the clear lamp.

Lighting Equipment.—The modern industrial reflector is a development from the tin shade of the obsolete drop-pendant system of lighting. Its purpose, unlike that of the shade, is to control the light which emanates in all directions from the lamp and distribute it within certain prescribed limits. Vitreous enamelled steel has established itself as the most popular material for use in industrial reflectors, since it is robust, easily moulded, and the surface is a comparatively efficient reflector of light. Under normal conditions the design of reflecting equipment affords sufficient protection to the lamp, but where still greater protection is needed wire guards may be fitted over the mouths of the reflectors. Occasionally lighting fittings have to be installed in an acid-laden or highly-inflammable atmosphere. In the former case all metal-work must be rendered acid-proof, and it is common in both instances to enclose the lamp in

Fig. 5.—General Overhead Lighting supplemented by Sidelighting by Angle Reflectors ensures Good Quality Work in this Loco. Erecting Shop.

a protecting glass globe. It is essential that fittings employed for industrial lighting shall have the qualities of permanence, simplicity, durability, efficiency and ease of maintenance.

Standard Dispersive Reflectors.—This open type of reflector is constructed of vitreous enamelled steel, and is designed for use with gas-filled lamps. It gives a maximum intensity of light in the 0-deg. to 45-deg. zone, and makes wide spacing compatible with uniform illumination. The light distribution ensures satisfactory illumination on both horizontal and vertical surfaces. The reflector has been standardised and is marketed by the leading manufacturers under the British Standards Specification No. 232, which controls its efficiency, light distribution, and angle of cut-off. The angle of cut-off ensures that glare is reduced in accordance with Home Office recommendations, and this type of reflector is considered suitable for all kinds of work and industries where a uniform system of general lighting is required.

Industrial Diffusing Units.—There are now available industrial units which combine a direct reflector with opal glassware. The illumination

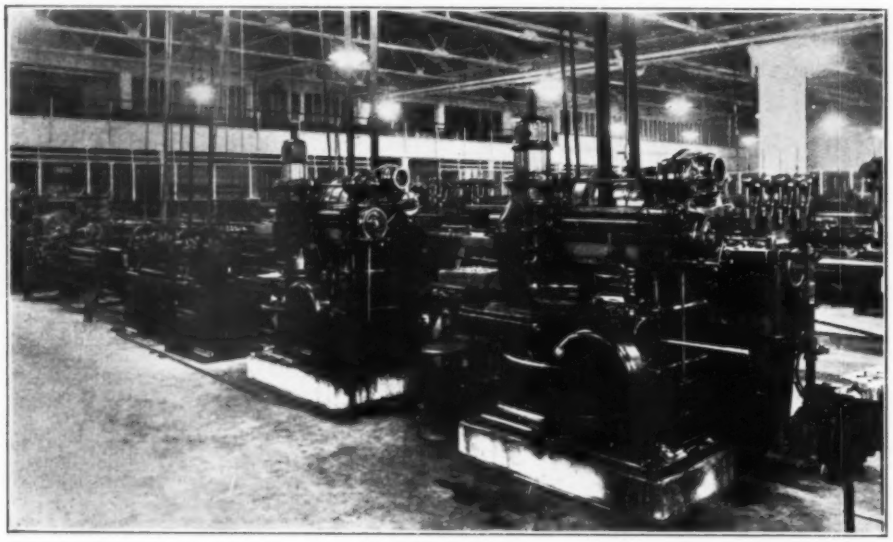


Fig. 6.—General Overhead Lighting with Industrial Diffusing Fittings provides Adequate Illumination on both the Horizontal and Vertical Working Surfaces of Machine Tools such as these.

provided by fittings of this character is well diffused and enables an even wider spacing-mounting-height ratio to be employed. Industrial diffusing units are particularly suitable for those shops requiring a high intensity of general lighting, since it is possible to achieve this without undue dazzle in consequence of the comparatively low brightness of the light source as represented by the globe. Units of this type are particularly suited to the lighting of fine assembly shops and for the examination of polished articles or plated goods. In addition, they find ready application in works offices and drawing offices, since they do not rely on the reflecting properties of the ceiling.

Concentrating Reflectors.—The concentrating type of reflector, usually of vitreous enamelled steel, is designed chiefly for lighting shops where the mounting height is considerable. These reflectors are usually installed above the crane and concentrate the light in a downward direction giving a maximum intensity to the 0-deg. to 25-deg. zone. The light distribution of these reflectors necessitates their installation at a distance not exceeding their mounting height above the plane of work if reasonably uniform illumination is to be obtained.

Angle Reflectors.—Angle reflectors of vitreous enamelled steel are frequently employed in large works to augment the illumination available from the overhead system. They are usually installed on side walls or columns at a height of 15 ft. to 20 ft. from the ground. Their use ensures that vertical surfaces are well lighted, and in consequence they find ready application in coach works, paint shops and any industry where much work is done on vertical surfaces.

Local Lighting Fittings. — For inspection benches, fine assembly work and any operation calling for a high degree of illumination, local lighting of some type is essential, and modern fittings designed for this purpose completely screen the lamp from view, concentrating the light downward on to the comparatively restricted working plane. Local lighting reflectors usually consist of small vitreous enamelled steel concentrating reflectors housing diffusing bulb lamps, and they are in the majority of instances so mounted that the whole fitting can be adjusted to enable the operative to control the direction of the light.

Lighting Systems.

Lighting installations in factories can be roughly divided into the three following classes:—(1) General overhead lighting, (2) localised overhead lighting, (3) combination of general lighting and local lighting. The suitability of each class depends entirely upon the nature of the work.

General Overhead Lighting.—General overhead lighting is usually achieved by the suspension of wide-angle reflectors at a minimum of 10 ft. from the floor and so spaced that the illumination is substantially uniform throughout the interior. The work can then be carried out with equal facility in almost any position, and should it be necessary to alter the lay-out of the plant the lighting system need not be interfered with. This system of lighting ensures ample headroom and freedom from dense shadows and glare, while maintenance costs are low since units are clear of damage and free from the possibility of lamp pilfering. A general overhead system gives even the largest and most complicated workshop a clean, well-organised appearance.

Localised Overhead Lighting.—This system is similar in principle to the general lighting system, except that the lighting fittings are installed in groups located in accordance with the demands of large plant or machinery whose top hamper or bulk would interfere with a general overhead system. There are many industries where this localising of overhead light sources is essential, and it is in connection with the lighting problems of this type that extensive experience of similar problems is called for. The textile industry, for instance, presents many such difficulties and necessitates careful thought in the design of the lighting system.

Combination of General Lighting and Local Lighting.—This class of installation is called for in those shops where high values of illumination are required for fine operations. As a general rule, best results are obtained when the overhead lighting system is installed and supplemented by well-designed local lighting equipment. Care must be exercised in the design of systems of this kind to ensure that the variation in illumination provided throughout the room by the two systems of lighting is insufficient to produce a subtle form of ocular discomfort by virtue of too great a contrast in brightness.

Special Problems.

In addition to the ordinary lighting problems encountered in engineering shops, there are certain industries including those where explosive atmospheres are encountered which necessitate the exercise of great care in the design of the lighting installation. Special fittings are available embodying vapour-proof and airtight construction to operate in dangerous atmospheres, and also for work where excessive water vapour is encountered. Another large field of industrial lighting is that for outdoor work, such as in shipbuilding yards, docks, wharves, quarries, building construction, etc. In many of these cases, floodlighting by means of specially-designed projectors is coming into favour due to the fact that it enables the light sources to be situated at a considerable distance from the working point. It is, perhaps, in these special fields of industrial lighting that more rapid development and experimental lighting work is occurring than in the more regular applications.

Until recently, many of these occupations, such as railway shunting, dock work, etc., were looked upon as intrinsically hazardous when pursued after dark, but the development of modern lighting equipment is overcoming these difficulties, proving again that, whereas poor lighting costs money, good lighting saves money.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

13,269. Klockner-Werke Akt.-Ges. Abteilung Georges-Marienwerke. Manufacture of ingots. 366,377.

13,895. Pemetzrieder, G. Centrifugal casting of metals. 366,385.

15,389. Charbonnier, R. Dies employed in the manufacture of bolts and other articles. 366,396.

22,209. Vereinigte Stahlwerke Akt.-Ges. Manufacture of sheet-metal containers or the like. 366,424.

26,599 Schloemann Akt.-Ges. Rolling mills. 366,436.

18,268. Hevi-Duty Electric Company. Rotary-hearth furnaces. 366,409.

Sectional Meeting of the World Power Conference.—The Swedish National Committee of the World Power Conference, acting in agreement with the National Committees of Denmark, Finland and Norway, announce that a sectional meeting of the World Power Conference will be held in Scandinavia from June 26 to July 10, 1933. The Conference will be devoted to a study of the power questions of large-scale industry and of transport. The technical sessions will take place in Stockholm. In connection with the Conference it is planned to arrange lectures, inspections, tours in Denmark, Norway and Sweden, and an excursion to Finland.

This Week's News in Brief.

Trade Talk.

The Stanton Ironworks Company, Limited, is blowing out two furnaces at its Stanton Old Works for relining.

Messrs. Pittevil & Company, 46, Victoria Street, London, S.W.1, inform us that seven Sesci furnaces have now been sold in Great Britain.

The British Mannesmann Company, Limited, has secured a proportion of the contract for a new pipeline for the Iraq Petroleum Company.

Messrs. G. P. Wincott, Limited, of Sheffield, have secured a contract from the English Steel Corporation, Limited, for two Siemens-type furnaces.

Messrs. Sir W. G. Armstrong, Whitworth & Company, Limited, Newcastle, have handed over to the London & North-Eastern Railway the "Tyneside Venturer," the first Diesel-electric railcar to be completed by the firm. The car, which has accommodation for 60 passengers and a speed of 65 m.p.h., will be put into service on the branch lines round Newcastle.

The ascertainment price of No. 3 Cleveland G.M.B. pig-iron for the first quarter of 1932 is 53s. 2.61d. per ton, compared with 53s. 2.51d. per ton in the preceding quarter. Under the sliding scale arrangement the wages of Cleveland blastfurnacemen will remain unchanged. Wages paid by manufacturers of the Sheet Trade Board have been reduced by 2½ per cent. under the sliding scale.

Presiding at the annual meeting of the Ford Motor Company, Limited, held recently, Sir Percival Perry (chairman) said that they had not made such rapid progress towards the completion of their works at Dagenham as was anticipated. The principal cause for delay had been that they had met with exceptional and unforeseen difficulties in preparing the base and foundation for their power house.

Negotiations have been resumed between the Belgian makers of crude steel concerning their respective quotas in connection with the projected renewal of the Continental Steel Cartel. The prospects of an agreement are said to be better, and as the French market has largely been closed by the quota system, it is thought that the dissident Belgian works may be won over to the prolongation of the Cartel.

H.M.S. "Cygnet," the first of the two destroyers launched at Barrow last year for the Admiralty, has been completed at the Barrow shipyard of Messrs. Vickers-Armstrongs, Limited. The other destroyer, H.M.S. "Crescent," has already gone through her preliminary trials. In the last few days Messrs. Vickers-Armstrongs have launched at Barrow two more destroyers for the British Navy They were named "Defender" and "Diamond."

Presiding at the annual meeting of the Carron Company Works Welfare Club last week, Mr. H. Medcalfe, the President, announced that the season had been the most successful in the history of the club. The club had competed for the George Ure Trophy, a competition confined to establishments of at least 50 years' standing, and in which players must have at least 25 years' service with the same firm. They had not been successful in winning the cup, which had been won by the Falkirk Iron Company club.

Contracts Open.

Carrickfergus, April 27.—Supply and laying of 740 yds. of 3-in. cast-iron water pipes, with valves, etc., for the Larne Rural District Council. Mr. S. Robinson, engineer, Victoria Street, Larne.

Salford, April 25.—Transformer, for the Corporation. The City Electrical Engineer, Electricity Department, Frederick Road, Salford.

The plates of a boiler plant to be shut down should be cleansed with a dilute solution of sodium carbonate, and, when this is dry, spray with a light petroleum oil to prevent rusting.

Five per cent. nickel steel can be pickled by immersing for 15 min. in a 50 per cent. solution of hydrochloric acid at 140 deg. Fah. Then dip in pure nitric acid, and finally rinse.

Personal.

Mr. H. J. Rhodes, chairman of the Scottish Tube Company, Limited, has joined the board of Messrs. Stewarts & Lloyds, Limited.

Sir George Beharrell was elected President of the Federation of British Industries for the coming year, in succession to Sir James Lithgow, at the annual meeting held recently. Mr. W. J. U. Woolcock and Sir Roland Nugent were elected Vice-Presidents.

Mr. C. G. Atha, who has been one of the managing directors of Messrs. Stewarts & Lloyds, Limited, since 1920, and Mr. George H. Mitchell, who has been a director of the company for 25 years, have resigned their seats on the board. Appreciative reference to their services to the company was made at the annual meeting last week.

Wills.

Barnet, John, of Kirkcaldy, of Messrs. Barnet & Morton, Limited, iron merchants	£8,961
Hall, J. R., of Bolton-de-Sands, Lancs, formerly a director of the Carnforth Hematite Iron Company (1915), Limited	£14,626

Obituary.

Mr. Fred Parr, a director of Messrs. G. R. Jones & Company, Limited, steel and file manufacturers, Sheffield, has died at the age of 57.

The death occurred, on April 16, of Mr. John Fleming, head of the firm of Marshall Fleming & Company, Limited, Dellburn Engineering Works, Motherwell.

Mr. Thomas McCarthy, a director of Messrs. William Gray & Company, Limited, shipbuilders, of Hartlepool and Sunderland, died at West Hartlepool on Wednesday, aged 68.

Mr. Alexander C. D. Poole, works manager for Messrs. Hall & Pickles, Limited, at their steelworks, Bessemer Road, Attercliffe, Sheffield, died suddenly last week while on a business visit to London. He was 55 years of age.

One of Motherwell's prominent figures, Mr. Robert S. Wilson, J.P., manager of the Dalzell Works, Motherwell, of Colvilles, Limited, died in a Glasgow nursing home early last Saturday morning. He had been ill for a fortnight, and died unexpectedly from a chill following a successful operation.

The death has occurred, in Bearsden, of Prof. R. W. Dron, of the James S. Dixon Chair of Mining in the University of Glasgow. Prof. Dron, who was appointed to the chair in 1923, was a son of the founder of the firm of Dron & Lawson, machine-tool makers, and held a prominent position as a consulting engineer. Apart from professional affairs he took a deep interest in public matters, particularly education. He was chairman of the Dumbarton Education Authority from 1920 until the establishment of the Local Government (Scotland) Act, 1929, when he became chairman of the Education Committee of the County Council of Dumbarton.

Company Reports.

Victaulic Company, Limited.—Net loss for 1931 of £5,396.

Babcock & Wilcox, Limited.—Final dividend of 7 per cent., less tax, making 14 per cent., less tax, on the ordinary shares for 1931.

Smith & McLean, Limited.—Trading profit, £3,357; taxation reserve transferred to profit and loss, £1,297; brought in, £19,287; preference dividend, £4,687; no dividend on the ordinary shares; carried forward, £19,254.

Stewarts & Lloyds, Limited.—Profit, £317,272; brought in, £134,207; depreciation, £150,000; to special reserve, £75,000; no dividend on the deferred or liaison deferred shares; carried forward, after meeting preference dividends, £137,119.

Company Meeting.

Stewarts & Lloyds, Limited.

The annual meeting of Messrs. Stewarts & Lloyds, Limited, was held in Glasgow on April 12. Mr. A. C. Macdiarmid (chairman), who presided, referred to the collapse of demand throughout the world and the intense difficulties of international trading caused by financial and exchange complications, and said that with a company whose interests were so widespread as theirs such conditions could not fail to affect trading results very seriously. They had, however, the satisfaction of knowing that both at home and abroad they had more than maintained their position, having assured at least their full share of the meagre world demand available, and figures showed that the export trade of the wrought-iron and steel tube and pipe industry of Great Britain, of which on a tonnage basis they and their associates accounted for nearly 90 per cent., suffered a much less serious decline in 1931 than that suffered by the steel exports of the country generally. Notwithstanding this, their output of tubes made and sold during 1931 was just half that of 1929, although their capacity was considerably greater. The chairman regretted that he had no better news to give this year with regard to the progress of the companies interested in the development of the Coley process. A year ago he referred to the phenomenal fall in the price of spelter, which had then reached the lowest figure ever recorded. Since then even lower prices had been reached and the industry was still labouring under extremely difficult conditions. They understood that zinc oxide could be profitably produced by the process, and they still believed that it had important potentialities. Satisfactory results could not, however, be looked for from their investment until the general position improved substantially. Meanwhile they were maintaining their interest in the N. C. Metal Company and the Zinc Manufacturing Company. With regard to the supply of raw materials for steel and tube manufacture, they had secured their position and created a situation which, when the time was opportune, could be developed in such a way as to ensure to them at all times the fullest competitive strength with the advantage of the latest and best developments of their competitors. Having now had more than a year's experience of their liaison with Tube Investments, Limited, they were satisfied of the wisdom of establishing that connection. Joint study of problems connected with the industry had been undertaken, and the value of the co-operation between the two companies would increase and become more apparent as time went on. They looked forward confidently to similar advantages accruing from their more recent association with the Scottish Tube Company. Some years ago, with the object of avoiding the collapse in prices which had been so marked a feature in the case of other commodities, they entered into certain arrangements with the principal tube manufacturers of the world. It appeared likely that these arrangements, which had proved of considerable value to the company, must come to an end at March 31, 1932. He was pleased, therefore, to be able to state that they and their associates had been successful in negotiating a new arrangement, under which the more-favoured position in which British manufacturers found themselves as the result of the departure from the gold standard and the changed fiscal policy of the country was properly recognised. Concluding, the chairman mentioned the Iraq pipe line. While details of the whole matter were not yet definitely settled, they had already received orders in connection with the Iraq Petroleum Company's oilfield development for some 350 miles of 12-in. weldless steel pipe, and expected shortly to receive further orders bringing this up to about 400 miles. The steel (about 50,000 tons) would be made in their own works, and the job from the ore upwards would be 100 per cent. British material and workmanship.

Losses of American Steel Companies in 1931.—The aggregate net loss during 1931 of 27 companies engaged in the production and rolling of steel amounted to $14,622,526, compared with a profit of $168,300,646 in 1930. The companies included account for at least 95 per cent. of the United States' steel-making capacity, and of that number only 10 reported a profit.

Raw Material Markets.

Orders for iron and steel are slow to come in, export business, in particular, being at a low level. The poor demand is, of course, largely due to the fact that there is so little work for the consuming industries. The markets were inclined to await news of the Budget before making any move, but now that further protection for iron and steel seems very probable the volume of buying should show a definite increase. The pig-iron markets will not be directly affected, as little Continental iron has been imported for quite a long time. Quiet conditions continue to prevail in the sheet and tinplate trades.

Pig-Iron.

MIDDLESBROUGH.—The market has remained steady during the week, hopes of industrial expansion being regarded as a little premature as yet. One favourable sign is the increase in sales of Cleveland iron in Scotland, where a greater proportion of the business available is being taken. Prices in that area, however, have been cut so low that they offer little remuneration to the producers. Prices to English and foreign consumers are as follow:—No. 1 Cleveland foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton, f.o.t. or f.o.b.

The tone of the East Coast hematite market has improved on the strength of the better prospects of the steel trade. Another favourable factor is the disposal of the heavy stocks held by the merchants that had long depressed the markets. The producers are obtaining 63s. 6d. per ton for spot lots, but have accepted 63s. for several large orders. Business in West Coast hematite has been spasmodic during the past week, the market being weakened by the fact that the two local steelworks were not in operation. There continues to be a good volume of inquiry, but little comes of it. West Coast mixed numbers remain at 66s. per ton at works.

LANCASHIRE.—Owing to the poor state of the consuming industries in this area, new orders for pig-iron are extremely scarce, although several Midlands producers report that contract deliveries to Lancashire have been steadily maintained. Little demand is being experienced from the textile machinery makers. For delivery to users in the Manchester area, Midland brands—Derbyshire and Staffordshire—are maintained at 67s. per ton, with North-East Coast iron at about this figure, Northamptonshire foundry at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at about 86s. 6d. and West Coast hematite at 81s. Indian iron ranges from about 75s. to 77s. 6d. per ton delivered.

MIDLANDS.—Little business arose from the Birmingham quarterly meeting last week, the foundries, even the light-castings section, being poorly employed and indisposed to buy. Forward buying is seldom mentioned, in spite of the number of contracts running out or about to do so. Any fresh duty on foreign iron and steel should stimulate the flow of business. Quotations remain at 62s. 6d. for Northants No. 3 and 66s. per ton for North Staffordshire, Derbyshire and Lincolnshire No. 3, delivered to Birmingham and Black Country stations or sidings.

SCOTLAND.—The furnaces in blast in Scotland are ample to satisfy the limited needs of the market, which has reached a state of inertia that will take some time to overcome. The light-castings section of the foundry trade is not exempt from the general depression, and the Falkirk foundries are working only two or three days per week. No. 3 Scottish foundry iron remains at 69s. 6d. per ton f.o.t. furnaces, with 2s. 6d. extra for No. 1. No. 4 is at 68s. 6d. f.o.t. Coatbridge. No. 3 Middlesbrough is at 58s. 6d. at Grangemouth, and No. 4 at 1s. less. Other English irons are obtainable at 57s. 6d. for No. 3 at Grangemouth. Regular shipments of Indian iron have been arriving, but no Continental foundry iron is on offer

Coke.

Little business is being done in the foundry-coke market, the few orders received being mostly for small lots for immediate delivery. Best Durham coke is at 37s. 6d. to 40s., delivered Birmingham and district, with other grades at down to 35s., while Welsh coke varies according to analysis from 30s. to 45s., delivered.

Steel.

The dominant feature of the semi-finished steel market is the extremely low prices quoted by the Continental works, which, however, are meeting with little success, owing to the lack of activity amongst consumers in this country. On the other hand, considerable quantities of small steel bars are still being imported from the Continent, and stocks are being built up which will nullify the effects of any new duty for some time to come. The heavy engineering trades remain depressed, and few specifications are forthcoming from that direction.

Scrap.

Prices are slightly firmer in the Cleveland scrap-iron market, although the foundries' needs are still limited. Buyers are paying 40s. per ton for ordinary heavy metal in small parcels, and good machinery quality realises 42s. 6d. Light castings are at about 35s. The ironfounders in the Midlands are still very slack, and it is difficult to dispose of cast-iron scrap in any quantities. Heavy machinery cast iron broken into handy sizes is offered at 47s. 6d. per ton delivered, and in some cases even less, but has few buyers Heavy cast-iron pipe and plate is offered at 42s. 6d. per ton delivered, and clean light at 37s. 6d. to 40s. per ton delivered. Only a slack demand is being experienced from the Scottish foundries, which have great difficulty in finding work. Light cast-iron scrap is unchanged at 38s. 6d. to 40s., while 51s. 6d. to 52s. 6d. is quoted for machinery cast-iron scrap in pieces not exceeding 1 cwt., with ordinary cast-iron scrap to the same specification at 45s. to 46s. In South Wales, quotations for scrap iron are mostly nominal, owing to the lack of buying.

Metals.

Copper.—The standard market has borne a steadier appearance during the past week, mainly owing to buying from the Continent and to a weakening of the sterling exchange. On Monday the price of Customs metal, which had been 6 cents c.i.f., was raised to the official level of 6¼ cents. Industrial prospects in America are not encouraging, and many copper producers are casting doubts upon the value of the output restriction scheme. Sir Auckland Geddes championed it at the meeting of the Rio Tinto Company last week, but, in view of the improbability of consumption ever returning to its former level, the elimination of the high-cost mines would seem the most economically sound proposition. The necessary lowering of prices might also stimulate some revival in consumption.

Closing quotations:—

Cash.—Thursday, £29 8s. 9d. to £29 10s.; Friday, £30 7s. 6d. to £30 10s.; Monday, £30 11s. 3d. to £30 12s. 6d.; Tuesday, £29 15s. to £29 17s. 6d.; Wednesday, £29 11s. 3d. to £29 13s. 9d.

Three Months.—Thursday, £29 15s. to £29 16s. 3d.; Friday, £30 13s. 9d. to £30 15s.; Monday, £30 17s. 6d. to £31; Tuesday, £30 2s. 6d. to £30 3s. 9d.; Wednesday, £30 to £30 2s. 6d.

Tin.—The price of standard tin has recovered from its recent drop, and last week's wave of "bull" liquidation appears to have spent itself. Consumers in England and on the Continent have been buying to a certain extent, but consumption remains at a low level in the U.S.A. It is thought, however, that many American consumers will soon have to enter into new forward contracts, as they have been relying on their stocks alone for several months.

Official closing prices:—

Cash.—Thursday, £103 15s. to £104; Friday, £105 to £105 2s. 6d.; Monday, £106 to £106 5s.; Tuesday, £106 7s. 6d. to £106 10s.; Wednesday, £108 7s. 6d. to £108 10s.

Three Months.—Thursday, £106 to £106 2s. 6d.; Friday, £107 to £107 2s. 6d.; Monday, £108 to £108 5s.; Tuesday, £108 12s. 6d. to £108 15s.; Wednesday, £110 7s. 6d. to £110 10s.

Spelter.—This metal is in a better position than any of the others, owing to the fact that the producers, while restricting their output, have not attempted to control the price. Buying has been steady on the Continent for some weeks, while the galvanised-sheet trade in this country is moving into a slightly more favourable position, as is evinced by the March export statistics.

Daily fluctuations:—

Ordinary.—Thursday, £11 8s. 9d.; Friday, £11 17s. 6d.; Monday, £12 6s. 3d.; Tuesday, £12 5s.; Wednesday, £12 7s. 6d.

Lead.—A withdrawal of sellers and a slight revival of buying interest have contributed towards the firmer tone in the market this week. By all signs, deliveries to American consumers are likely to show an increase this month, but the poor position of the metal on the Continent remains unrelieved.

The week's prices have been:—

Soft Foreign (Prompt).—Thursday, £11 6s. 3d.; Friday, £11 8s. 9d.; Monday, £11 11s. 3d.; Tuesday, £11 6s. 3d.; Wednesday, £11 6s. 3d.

Symposium on Steel Castings.

A Symposium on Steel Castings, jointly sponsored by the American Foundrymen's Association and the American Society for Testing Materials, will be held in Atlantic City, June 20 to 24. The first, held at the 1931 Annual Meeting in Chicago, was devoted to malleable-iron castings. Plans for the Symposium on Steel Castings have been formulated by an Advisory Committee. Two sessions are contemplated in which the Papers listed below will be presented.

First Session.

Introduction: W. C. Hamilton, American Steel Foundries.

Statistics Covering Steel Castings: Steel Founders' Society of America.

General Data on Steel Castings and Their Fields of Application Governed by the Various Physical Properties: C. E. Williams and C. H. Lorig, Batelle Memorial Institute.

Test-Bar Specifications, including the Relationship between Physical Properties obtained from Coupons and the Physical Properties of the Metal in the Castings: R. A. Bull, Electric Steel Founders' Research Group.

Second Session.

Development of Alloy Steels for Castings: (*a*) Pearlitic Steel Castings: Fred Grotts, Continental Roll & Steel Foundry Company. (*b*) Iron-Chromium, Iron-Chromium-Nickel and Related Alloys: Data to be obtained from Committee A-10, A.S.T.M., Jerome Strauss, Vanadium Corporation of America. (*c*) Austenitic Manganese Steel Castings: J. H. Hall, Taylor-Wharton Iron & Steel Company.

Problems in the Heat-Treatment of Steel Castings: A. W. Lorenz, Bucyrus Erie Company.

Welding: T. S. Quinn, Lebanon Steel Foundry.

General Principles of Design as Related to Physical Properties, Soundness and Ease of Production: F. A. Lorenz, jun., American Steel Foundries.

Aluminium Foundry Data.—Published by the British Aluminium Company, Limited, Adelaide House, King William Street, London, E.C.4.—We distinctly remember, when we reviewed the predecessor (No. 313) to the booklet (No. 328), that we said it would be better appreciated if a charge were made for it. It contains a wealth of reliable, up-to-date material, and, moreover, it is extremely suggestive of new ideas for the light-alloy founder. We fail to see how anyone casting light alloys can possibly possess such a quantity of live data within reasonable space. It gives the specifications of the commoner alloys, tells how to melt, make moulds, cast, heat-treat, machine, weld and polish them. This, without wasting a line, takes up 37 pages, and a balance of 13 pages is devoted to illustrating typical castings covering the widest possible field. We strongly recommend our readers to procure for themselves a copy of this extremely worth-while publication.

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PIG IRON
BRANDS "DALZELL" "GLENGARNOCK" "CLYDE" & "MONKLAND"
HIGH GRADE HEMATITE PIG IRON
SPECIAL & ORDINARY FOUNDRY QUALITIES & FORGE
SPECIAL REFINED WITH TOTAL CARBON
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CAST IRON FLANGED PIPES

2 in.–12 in. & CONNECTIONS. to 24 in. dia.

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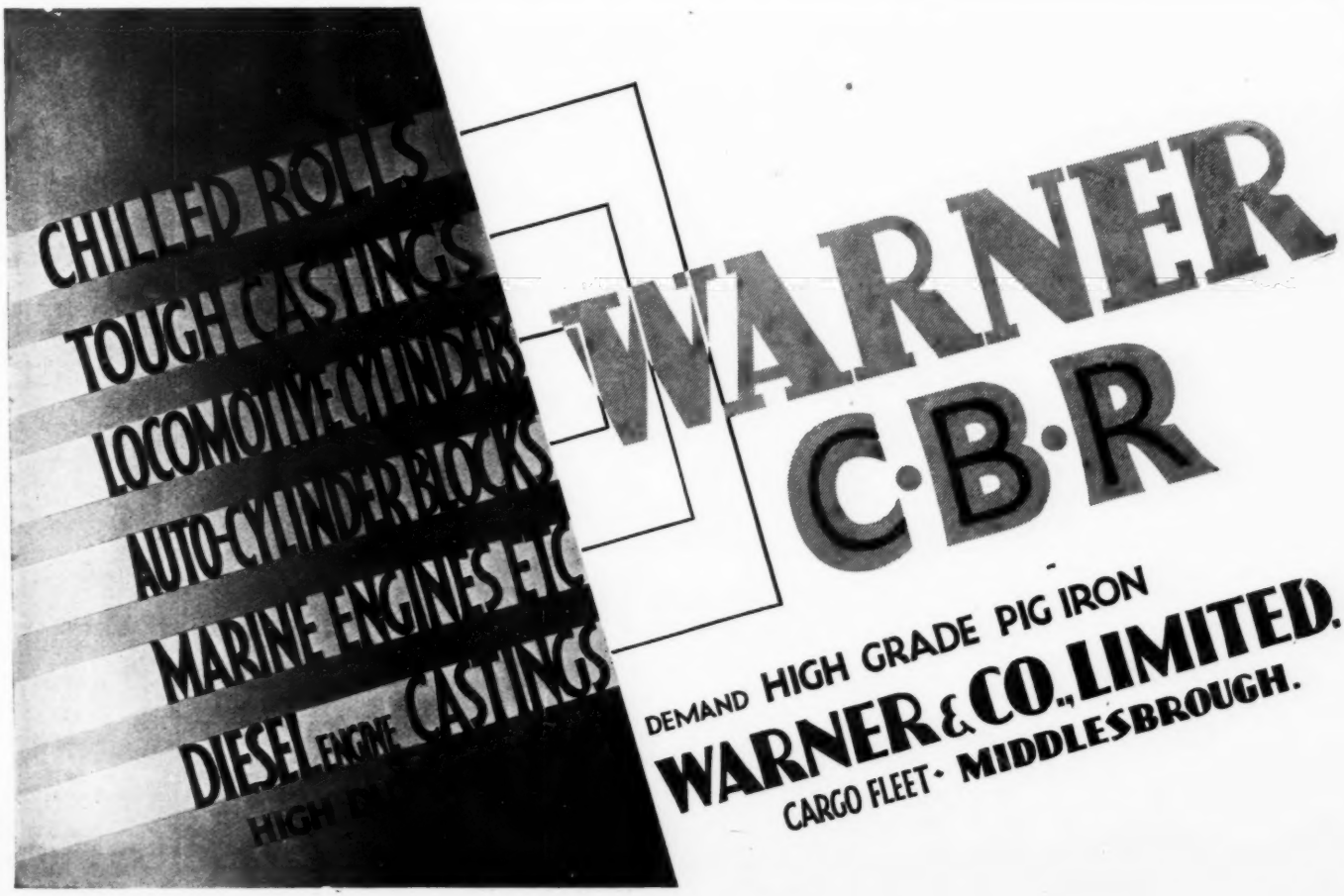

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	29 11 3
Three months	30 0 0
Electrolytic	34 0 0
Tough	33 0 0
Best selected	33 10 0
Sheets	63 0 0
India	44 0 0
Wire bars	36 5 0
Do., May	36 2 6
Do., June	36 0 0
Ingot bars	36 5 0
H.C. wire rods	38 10 0
Off. av. cash, Mar.	33 1 9 1/16
Do., 3 mths., Mar.	33 6 2 1/2
Do., Sttlmnt., Mar.	33 1 10 7/16
Do., Electro, Mar.	37 5 1 1/2
Do., B.S., Mar.	36 10 3 1/2
Do., wire bars, Mar.	37 14 6 1/2
Solid drawn tubes	9 1/2d.
Brazed tubes	9 1/2d.
Wire	6 1/2d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8 1/2d.
Rods, extd. or rlld.	4 1/2d.
Sheets to 10 w.g.	7 1/2d.
Wire	7 1/2d.
Rolled metal	7d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£ s. d.
Standard cash	108 7 6
Three months	110 7 6
English	110 0 0
Bars	109 15 0
Straits	110 7 6
Australian	107 17 6
Eastern	111 10 0
Banca (nom.)	115 7 6
Off. av. cash, Mar.	129 18 2 1/2
Do., 3 mths., Mar.	131 12 6 1/2
Do., Sttlmt., Mar.	129 17 10 1/2

SPELTER.

	£ s. d.
Ordinary	12 7 6
Remelted	11 0 0
Hard	10 5 0
Electro 99.9	14 10 0
English	13 0 0
India	11 15 0
Zinc dust	22 0 0
Zinc ashes	2 5 0
Off. aver., Mar.	12 16 4 1/2
Aver. spot, Mar.	12 12 3 1/2

LEAD.

	£ s. d.
Soft foreign ppt.	11 7 6
English	13 10 0
Off. average, Mar.	12 9 9 1/2
Average spot, Mar.	12 6 10 1/2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	23 0 0
Do., V.M. ex-whf.	20 10 0
Rods	27 10 0
Boiler plates	—
Battery plates	—

ANTIMONY.

	£ s. d.
English	35 0 0 to 42 10 0
Chinese	26 0 0
Crude	18 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	16 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 15 0
45/50%	£12 10 0
75%	£17 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, 4/2, plus 55%, per lb. of Mo.	
Ferro-titanium—	
23/25% carbon-free	11 1/2d. lb.
Ferro-phosphorus, 20/25%	£20 2 6
Ferro-tungsten—	
80/85%	1/8 1/2 lb. plus 20%
Tungsten metal powder—	
98/99%	1/11 1/2 lb. plus 20%
Ferro-chrome—	
2/4% car.	£35 15 0
4/6% car.	£25 17 6
6/8% car.	£24 12 6
8/10% car.	£24 0 0
Ferro-chrome—	
Max. 2% car.	£36 17 6
Max. 1% car.	£44 0 0
Max. 0·70% car.	£52 5 0
70% carbon-free	1/1 lb.
Nickel—80/99.5%	£220 to £225
"F" nickel shot	£212 10 0
Ferro-cobalt	8/9 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 0 0
Metallic manganese—	
94/96% carbon-free	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/4 in. to 1/8 in.	3d. lb.
Do., under 1/8 in. to 3/16 in.	1/- lb.
Flats, 1/4 in. × 1/8 in. to under 1 in. × 1/4 in.	3d. lb.
Do., under 1/8 in. × 1/8 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	2 2 6 to	2 3 6
Bundled steel and shrngs.	1 17 0 to	1 18 0
Mixed iron and steel	1 17 0 to	1 19 0
Heavy cast iron		2 5 0
Good machinery for foundries		2 7 6
Cleveland—		
Heavy steel		1 15 0
Steel turnings		1 12 6
Cast-iron borings		1 6 0
Heavy forge		2 15 0
W.I. piling scrap		2 7 6
Cast-iron scrap	2 0 0 to	2 2 6
Midlands—		
Light cast-iron scrap		1 17 6
Heavy wrought iron		2 12 6
Steel turnings, f.o.r.		1 1 6
Scotland—		
Heavy steel		1 17 6
Ordinary cast iron		2 5 0
Engineers' turnings		1 10 0
Cast-iron borings		1 11 6
Wrought-iron piling		2 2 6
Heavy machinery		2 11 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	25 0 0
Brass	18 0 0
Lead (less usual draft)	10 0 0
Tea lead	7 0 0
Zinc	6 0 0
New aluminium cuttings	72 0 0
Braziery copper	22 0 0
Gunmetal	21 0 0
Hollow pewter	70 0 0
Shaped black pewter	50 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	63/6 to 64/-
Hematite M/Nos.	63/- to 63/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	75/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/6
Clyde, No. 3	86/6
Monkland, No. 3	86/6
Summerlee, No. 3	86/6
Eglinton, No. 3	86/6
Gartsherrie, No. 3	86/6
Shotts, No. 3	86/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£ s. d.	£ s. d.
Iron—		
Bars (cr.)	9 15 0 to	10 0 0
Nut and bolt iron		8 7 6
Hoops	10 10 0 to	12 0 0
Marked bars (Staffs) f.o.t.		12 0 0
Gas strip	10 10 0 to	12 0 0
Bolts and nuts, 1/2 in. × 4 in.		12 2 6
Steel—		
Plates, ship, etc.	8 15 0 to	8 17 6
Boiler plts.	8 10 0 to	9 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5 1/2 in.		9 7 6
Rounds under 3 in. to 1/4 in. (Untested)	6 12 6 & up.	
Flats—8 in. wide and over		8 12 6
under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0 to	8 10 0
Fishplates		12 0 0
Hoops (Staffs)		9 10 0
Black sheets, 24g.	8 0 0 to	8 10 0
Galv. cor. shts.	9 10 0 to	10 0 0
Galv. flat shts.	10 0 0 to	11 0 0
Galv. fencing wire, 8g. plain		12 10 0
Billets, soft	5 5 0 to	5 10 0
Billets, hard		6 12 6
Sheet bars	4 15 0 to	5 5 0
Tin bars		4 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10 1/2d.
Sheet to 10 w.g.	11 1/2d.
Wire	12d.
Rods	11 1/2d.
Tubes	16 1/2d.
Castings	12 1/2d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/2 to 1/7 1/2
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.59
No. 2 foundry, Valley	15.00
No. 2 foundry, Birm.	11.00
Basic	16.39
Bessemer	17.39
Malleable	17.39
Grey forge	16.89
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	43.00
Billets	27.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.50
Skelp, sheared steel	1.50
Steel hoops	1.65
Sheets, black, No. 24	2.20
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
furnace	17/- to 18/-
Durham and Northumberland—	
foundry	14/6 to 15/-
furnace	13/- to 13/6
Midlands, foundry	—
furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/-
	28×20 "	32/-
	20×10 "	23/-
	18 1/2×14 "	16/7 1/2
C.W.	20×14 "	14/-
	28×20 "	30/-
	20×10 "	19/10
	18 1/2×14 "	15/-

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£8 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Apr. 14	..	29	8	9	inc. 1/3
„ 15	..	30	7	6	„ 18/9
„ 18	..	30	11	3	„ 3/9
„ 19	..	29	15	0	dec. 16/3
„ 20	..	29	11	3	„ 3/9

Electrolytic Copper.

		£	s.	d.	
Apr. 14	..	34	0	0	No change
„ 15	..	34	15	0	inc. 15/-
„ 18	..	35	0	0	„ 5/-
„ 19	..	34	0	0	dec. 20/-
„ 20	..	34	0	0	No change

Standard Tin (cash).

		£	s.	d.	
Apr. 14	..	103	15	0	inc. 7/6
„ 15	..	105	0	0	„ 25/-
„ 18	..	106	0	0	„ 20/-
„ 19	..	106	7	6	„ 7/6
„ 20	..	108	7	6	„ 40/-

Tin (English ingots).

		£	s.	d.	
Apr. 14	..	105	5	0	No change
„ 15	..	106	5	0	inc. 20/-
„ 18	..	107	5	0	„ 20/-
„ 19	..	107	15	0	„ 10/-
„ 20	..	110	0	0	„ 45/-

Spelter (ordinary).

		£	s.	d.	
Apr. 14	..	11	8	9	inc. 6/3
„ 15	..	11	17	6	„ 8/9
„ 18	..	12	6	3	„ 8/9
„ 19	..	12	5	0	dec. 1/3
„ 20	..	12	7	6	inc. 2/6

Spelter (Electro, 99.9 per cent.).

		£	s.	d.	
Apr. 14	..	13	12	6	inc. 7/6
„ 15	..	14	0	0	„ 7/6
„ 18	..	14	7	6	„ 7/6
„ 19	..	14	10	0	„ 2/6
„ 20	..	14	10	0	No change

Zinc Sheets (English).

		£	s.	d.	
Apr. 14	..	23	0	0	No change
„ 15	..	23	0	0	„ „
„ 18	..	23	0	0	„ „
„ 19	..	23	0	0	„ „
„ 20	..	23	0	0	„ „

Lead (English).

		£	s.	d.	
Apr. 14	..	13	5	0	inc. 5/-
„ 15	..	13	5	0	No change
„ 18	..	13	10	0	inc. 5/-
„ 19	..	13	10	0	No change
„ 20	..	13	10	0	„ „

AVERAGE MONTHLY PRICES OF WEST COAST HEMATITE MIXED NUMBERS DELIVERED SHEFFIELD.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1893	46 0½	45 8	45 11	45 7	44 11	44 9½	44 10	45 3	45 0	44 6	44 7	45 8	45 3
1894	45 3	45 3	45 1½	45 1	43 11	43 11	43 9½	44 2	44 7½	43 7	43 5	43 3	44 3½
1895	42 8	42 5½	42 6	42 10	43 10	43 7½	44 10	45 11	49 11	48 9	47 7½	47 7½	45 2½
1896	47 0	48 9	48 9	48 2½	47 3	47 3	46 10	46 10	47 2	48 5	50 7	50 6	48 1½
1897	51 2	49 10	48 5	47 4	47 9½	48 6	47 0	47 3	47 3	47 0	48 3½	47 11	48 2
1898	48 9	48 10	49 4	49 8½	50 10	50 3½	51 0	52 5	53 11	55 8	57 3	56 10	52 1½
1899	59 1	59 9	57 7	59 6	64 7	70 10½	76 7½	72 2	74 3	75 0	78 1½	73 3	68 5
1900	75 3½	76 10	79 10	84 6	81 4	79 1½	83 4	81 5	79 11	76 10	77 8½	68 4	78 8
1901	60 2	59 0	57 9½	57 6½	57 8	57 4½	57 8	61 0	60 0½	59 9	58 7½	56 7	58 7½
1902	56 1	57 9½	59 3½	59 9	59 10½	60 0	60 0	60 8½	61 5	61 2	59 3	59 0	59 6
1903	58 5	58 8	61 1	59 5	57 10	57 3	56 7	56 3	55 9	54 8	52 4	52 4	56 8½
1904	52 8½	53 1	53 7	54 9	54 2	53 2½	52 9	52 5	52 2½	52 7	53 1	55 11½	53 5½
1905	57 9½	56 9	58 1	58 2	56 4	55 8	55 5½	56 7	61 0	68 9	69 9	70 11½	60 5½
1906	70 4½	65 2½	63 4½	63 9	64 5	64 6	64 1	66 2½	67 3	69 4½	72 4½	78 8½	67 5
1907	77 9	72 11	71 10	73 9	79 9½	76 9	77 9	78 4	75 11	72 9½	68 6	66 7	74 4
1908	62 7	59 1	61 6½	61 6½	61 4	59 1	57 9½	56 11	60 2	59 2	58 5½	57 7	59 7½
1909	51 4	56 5	55 3	56 1	56 4	57 0	56 8	58 0	61 0	61 1½	60 7½	61 4	58 1½
1910	64 0½	64 3½	66 10½	67 6½	66 2½	65 4	64 4½	65 6½	65 2	64 10½	64 6	65 6	65 4½
1911	66 9	66 1	64 10	63 1	62 1	62 0	61 2	62 2	62 1	61 1	61 10	64 0	63 1
1912	67 0	67 0	67 0	69 3	71 9½	72 11	75 9½	79 1½	82 2½	85 0	85 3½	86 6	75 9½
1913	86 6	86 6	86 3	85 0	83 6½	80 10½	78 1	76 10½	72 6	71 0	68 0	65 3	78 4½
1914	64 6	65 4½	65 6	64 11½	64 2½	64 0	64 0	68 11½	74 6½	71 0	65 4½	69 9½	66 10½
1915	78 9	100 6	103 1	113 6	111 9	114 0	116 3	115 2½	113 8½	121 1½	131 9½	139 6½	113 3
1916	135 0	135 0	133 4	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	129 2½
1917	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1918	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1919	127 6	127 6	127 6	127 6	180 6	184 3	195 4½	204 6	204 6	204 6	204 6	204 6	174 7
1920	224 9	235 0	245 0	275 0	290 0	295 0	295 0	295 0	295 0	295 0	295 0	280 0	284 11½
1921	263 4	228 4	180 0	180 0	180 0	160 0	160 0	157 6	142 0	128 6	121 0	115 6	167 9½
1922	125 0	117 6	115 0	115 0	115 0	115 0	113 1½	104 0	105 0	105 0	106 3	110 0	112 1½
1923	109 0½	116 5½	133 11½	138 3½	134 2	125 0	115 7½	111 9	110 0	110 0	113 11	115 0	119 5½
1924	115 0	115 0	114 4½	112 6	112 6	112 6	111 0	110 0	110 0	105 4½	102 6	102 6	110 3½
1925	102 6	102 6	100 0	98 6	97 6	95 1½	92 6	90 6	88 3	87 0	88 1½	88 9½	94 3½
1926	90 1½	90 0	89 8½	89 0	89 0	89 0	90 2½	91 9	94 0	97 2½	*	*	91 0
1927	95 4½	95 6	96 6	95 6	95 3	94 0	92 10½	91 6	90 6	90 6	90 6	89 6	93 1½
1928	85 0	85 3	85 5	85 0	85 3	84 9	84 0	83 9	84 0	84 0	83 1	82 6	84 4
1929	82 10½	83 6	85 0	86 9	87 0	87 0	87 3	87 2½	87 6	89 6	89 6	89 10½	86 11
1930	91 6	91 6	91 6	90 0	89 7½	88 0	87 7½	86 6	86 6	86 6	86 6	86 6	88 6½
1931	86 6	84 6	84 6	84 6	84 6	82 6	82 6	81 6	81 6	83 6	83 6	83 6	83 7
1932	83 6	83 6	83 6	—	—	—	—	—	—	—	—	—	—

* No prices available.

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